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Vol. XXI AUGUST. 1916. No. 8

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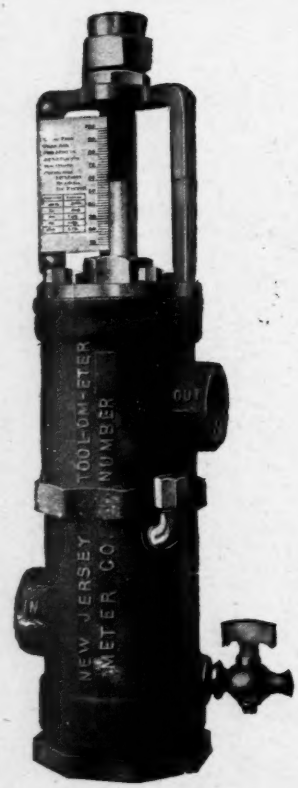

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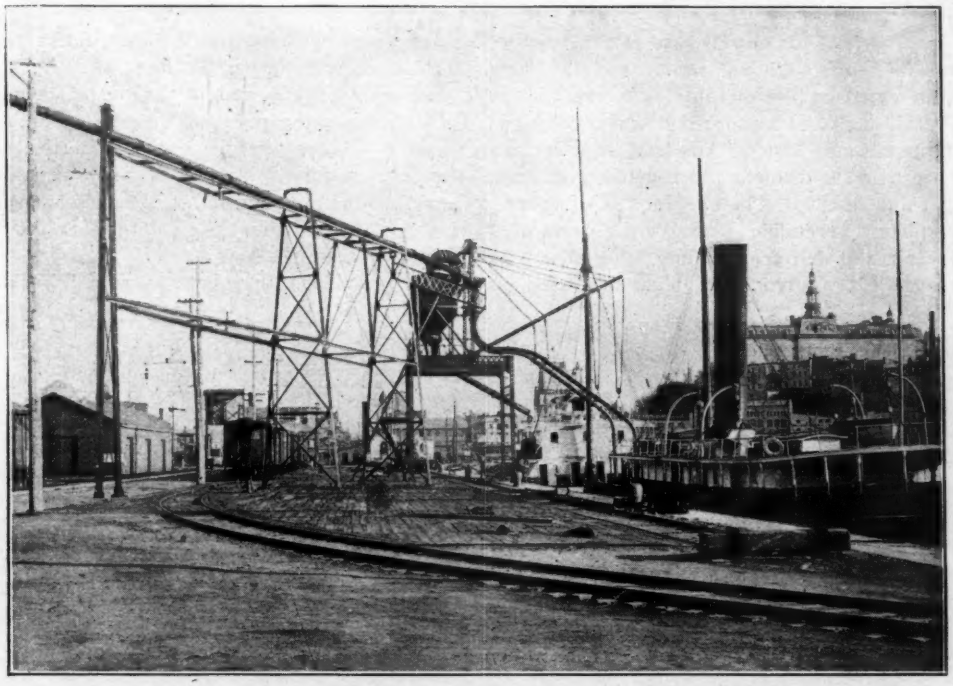
COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XXI AUGUST, 1916 No. 8



PNEUMATIC GRAIN CONVEYORS

It will be remembered that in COMPRESSED AIR MAGAZINE for December, 1915, we gave some descriptions with illustrations of pneumatic grain conveying apparatus employed at Manchester and elsewhere in England. This pneumatic handling of grain in bulk is now successfully employed at various points in the United States and Canada as attested by the photos here reproduced which speak for themselves. These are taken from installations of The Pneumatic Conveyor Company, Old Colony Building, Chicago.

Fig. 1 shows a steamer lying at a dock in Quebec, Canada, with the unloading operation in progress. Fig. 2 shows the horizontal pipe line by which the grain is conveyed, and Richardson Elevator into which it is delivered. Fig. 3 shows the several hose immersed in the grain in the hold and rapidly sucking it up. The suction operation delivers the grain into the large tank seen upon the steel framing,

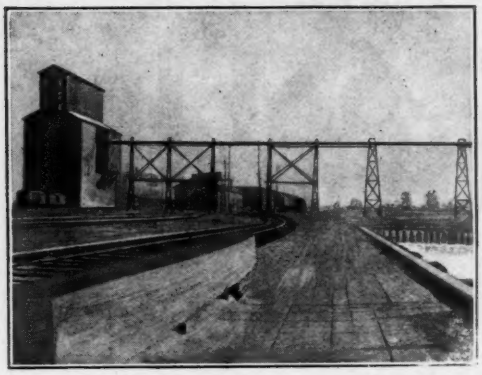


FIG. 2.

FIG. 3.

and then it is driven the remaining distance by air pressure.

The vertical lift in this case is about 90 ft. and the horizontal run nearly 700 ft. The grain entetring the elevator is received in a separate tank and air-locked down to the boot of the elevator lofter. The hose seen in Fig. 3 are 6 in. in diameter, corrugated, and very light and flexible. The operation is of course completely reversible, taking grain from the elevator and delivering it into other steamers as may be required. The plant has handled 4,800 bushels of oats per hour, discharging, and more than 6,000 bushels loading. The horse power consumed on this long line averaged about 2 H. P. per ton hour.

Six men are required in the boat and one on deck, with the regular house crew in the elevator. These six men, at this particular site, are required by the Longshoreman's Union, as the minimum in any boat. Two men in the boat are all that is necessary for about 75 per cent. of the cargo.

Fig. 4 shows a pneumatic marine lift dis-

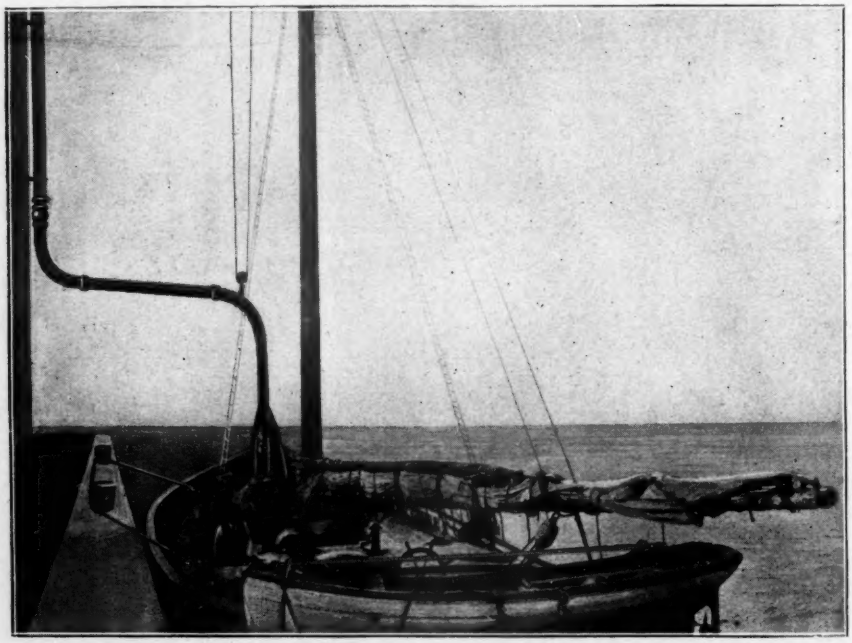


FIG. 4.

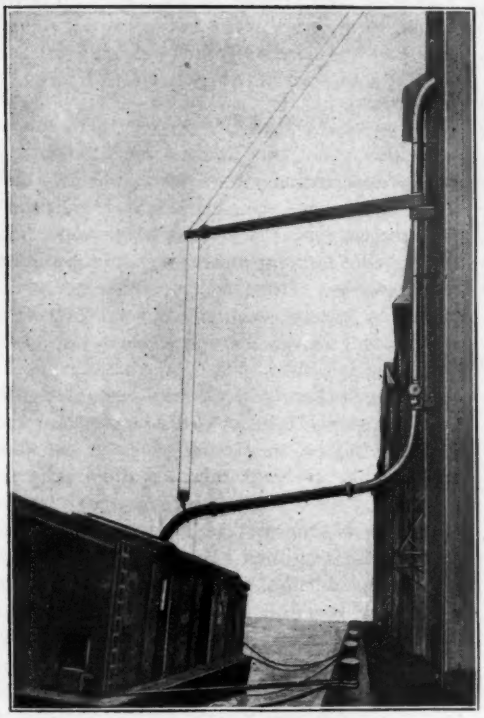


FIG. 5.

charging grain from a Bay boat at the Western Maryland Elevator, Baltimore, Md., and Fig. 5 shows the same lift discharging from a covered scow. The total vertical lift of this installation is 80 ft., with a horizontal carry one length of the boom. The grain is discharged directly into a receiving tank and from there is air locked to the bottom of the relift lofter. The exhauster is of the positive pressure rotary type, driven by motor through silent chain, and is placed on the dock floor.

The conveying pipe is carried down the outside of the tower, and the inland vertical leg of the swinging arm telescopes into this fixed pipe, so that the manifold with the several hose attached can be raised and lowered to accommodate boats of different sizes and their cargoes. The swinging arm is carried both to the inland and the water end by cables, and is operated from motor driven hoists within the tower.

The capacity of this installation is 2,500 bushels of wheat per hour, and it consumes slightly over 1¼ H. P. per ton hour.

WELDING JOINTS IN GAS MAIN CONSTRUCTION

The following paper by F. L. Hadley, Superintendent of Lines, Peoples Natural Gas Company, Pittsburgh, Pa., read before the Natural Gas Association, should be of special interest to the installers and users of compressed air. Welded piping both for natural gas, as dealt with in this paper, and for artificial illuminating gas is rapidly superseding all other types of pipe connection, but has not made as rapid progress in compressed air service for which it would seem to be specially adapted. It is cheap and rapid in application and is especially desirable for the elimination of all leakage. It is no more difficult to have tight piping for air than for gas, water or steam, but the air has not the same insistent habit as the others of making its escape immediately known, and so air leaks are apt to go undetected, but pipe welding is tight pipe insurance, and in these days should be generally adopted.

The subject which is treated in this paper is one which has become of great interest to all gas men and especially so to those interested in the construction and maintenance of lines and the transportation of natural gas from the field to the different markets.

From what we now know of the oxy-acetylene method of welding pipes together it appears as if the ideal method of constructing natural gas mains has been discovered and that it will mean as great a boom to the natural gas industry of the future as the discovery of the coupling was to the past, and while it is true that this method may not lead to the building of as many long lines to reach distant markets as did the development of couplings used in connection with plain end pipe, yet it will mean that the leakage as being one of the principal factors in the transportation of gas will be practically eliminated, effecting a saving of many thousand dollars annually to all of the large gas companies, besides giving us cheaper lines to build and operate.

This method of laying lines has been tried out very extensively by artificial gas companies during the past few years and in all cases of which we have knowledge it has been found to be very successful both in economy and in securing good tight lines. Some of the eastern companies are now welding all their exten-

sions, including the mains and service lines down to ¾-in. pipe. At the time which this paper is written the writer is engaged in installing such a plant which will consist of 14 miles of 8-in., 9 miles of 6-in. and approximately 10 miles of smaller pipe together with several hundred service lines of ¾-in. pipe all of which is to be welded, it being our intention to complete the entire plant without the use of a single fitting of any kind, with the exception of valves and stop cocks.

WELDING 7.5 MILES OF 10-IN. PIPE

The writer desires to give his experiences in building approximately 7½ miles of 10-in. line during last fall on which this method of joining the pipe was used in place of couplings or collars. This line was laid through rolling country with the highest hills of probably 300 ft., being in some sections somewhat rough with a number of small ravines. The pipe used was standard 10-in. I. D. line pipe furnished in long lengths which averaged about 35 ft. to the joint. In order to facilitate the welding we had the ends of the joints chamfered or beveled at an angle of 60 deg. which was done in the pipe mills without extra charge. By having the pipe thus chamfered the welder was able to start welding at once after the joints were lined up, otherwise it would be necessary that he melt down the edges of the pipe with the flame to secure a foundation before he would be able to start welding.

Heretofore in laying welded pipe we found that it was customary to lay the pipe in sections along the ditch and by turning the joints by means of tongs to allow the welding to be done on top of the pipe. We decided to make a little departure from this method and wherever the ground was suitable we laid the pipe joint by joint directly over the trench and did the welding without turning the pipe. While the welding was somewhat slower by reason of it being necessary to weld underneath the pipe, we found that we gained time in the end as we were able to slack the pipe directly into the ditch after the welds were made and to make the bends the same as if we were laying sewer pipe; that is by building fires and heating the pipe wherever it was found necessary to place a bend.

Owing to the rough character of the ground, we were obliged to make a great number of these bends, but in nearly all cases they were made as the welding progressed. In a few places we had men go ahead and make bends which were placed in the line when the welder came up but as a rule this was only to gain time in some certain rough section of ground.

TESTING THE JOINTS

In testing out this line we used 100 lbs. of gas pressure from one of our compressor stations and when completed was found tight with the exception of 5 leaks which were very small, being nothing more than little pin holes in the welds. These leaks can be easily repaired by placing additional metal upon the weld after the pressure has been taken off from the line.

During the laying of the line we subjected it to many severe tests in order to find out the strength of the welds and in only one case were we able to break them. For instance we would hold the pipe up to the top of the trench with one of the wooden horses and lower it into the ditch on both sides of the horse, then we would suddenly let go of the pipe and allow it to fall without any support to the bottom of the trench, then at other times we would leave 5 or 6 joints swinging in order to test the strength of the weld. We would make the bends in some cases nearly at the weld but at no time did we have any trouble with them not holding although the strain was very great where the bends were made without the line being blocked or braced. In fact we tried out the strength of the welds in every possible way in order to find out if there were any weak points in the construction of a welded line. In other words we did not want to give up the idea of welding our lines in the future unless it was proven to us that it was not practicable.

This one break which we had during the building of the line was caused by a poor weld, the pipe not being perfectly joined together although at a casual glance it had the appearance of being as strong as any of the other welds; yet upon a more careful examination we found that the two pipes had been simply tacked together with metal and the iron melted in between them without being united and making a continuous pipe. Fortunately for us the welder who made this weld was discovered in time, otherwise we might have had more trouble with defective welds.

CONTRACTION AND EXPANSION

Before and during the building of this line there was considerable discussion as to the

contraction and expansion on a welded line of this length, many holding that the line would pull apart at the welds owing to the contraction and expansion that they expected we would find on a line such as we were laying with only 20 in. of covering, that being the depth which we were having it buried. However we did nothing to take care of this as we took it for granted that the pipe itself would take care of any contraction or expansion that that there might be. In other words, we figured that when the line was finished we would have one continuous joint of pipe the same as if we had secured a 7-mile length from the mill and if it had been possible to secure such a joint of pipe nobody would have thought it necessary to have it cut and expansion joints or sleeves put in.

In this connection I can advise you that we have not had the slightest trouble with the line pulling apart, although there has been some severe cold weather since the line was put in commission. There have been two breaks, the first one shortly after the gas was turned into the line, which upon examination showed plainly that it came from a defective weld in which the pipe had the appearance of being burnt. The other break was caused by a sink in the surface of the ground at a coal mine and was a break which would have occurred on any line under like circumstances. Neither of these breaks showed any signs of there being contraction of the pipe, although the break at the mine took place during very cold weather.

COST

To secure welders we were obliged to pay a rate somewhat higher than the regular rate, yet with this high cost of labor the cost of the welds came slightly under the price of standard couplings such as is generally used on like lines, but this being our first experience in this kind of main line construction our costs were likely greater than they would have been had our experience been more extensive. I believe that a welded line can be laid with such economy that the cost of the joints will not be over two-thirds of what it would be if couplings were used.

WELDING WELL CASING

It might be of interest to the members of the association to know that during the time which we were engaged in laying the line above mentioned that we tried out oxy-acetylene welding on casing at one of our wells known as the R. A. Geary well or as it is more commonly known now, "The Deep Well." This well, on which we began work in November, 1911, is located about 4 miles out of McDonald, Pa., and at the time this paper was written had reached a depth of 7,181 ft., being by far the deepest well ever drilled in this country and only exceeded by one other well in the world. At the time of which I write we had in the well a string of 3½ in. I. D. or 4½ in. O. D. casing 6,320 ft. long with heavy collars.

In order to use a larger sized casing it was decided to pull out the screw pipe and run in a string of 5 in. with welded joints. The casing was furnished in 21 to 23-ft. lengths, the first 2,000 ft. being 5-in. O. D. or 4.29 in. I. D., 0.355 in. thick, weighing 17.611 lbs. per ft. Owing to the fact that there was an enormous water pressure on the lower casing it was heavier than that used above the water, which was 5 in. O. D. or 4.24 in. I. D., 0.288 in. thick, weighing 14.493 lbs. per ft., there being 4,320 ft. of this or a total length of 6,320 ft. in the string. On both weights the ends of the joints were chamfered 60 deg.

In placing the casing in the well there were two joints welded together outside of the derrick, then after the welding was completed these were placed in the hole and lowered down until only about 5 ft. remained above the derrick floor. Then two additional lengths were welded together in the yard as before and then brought into the derrick, raised and suspended in the air with the lower chamfered end resting upon the upper chamfer of the section previously placed in the well, then the welder proceeded to weld these sections together vertically, after which they were lowered into the hole.

In order to sustain as much of the weight as possible during the time that the casing was put in, a shoe was placed in the casing, this being an oak plug about 3 ft. long which was driven into the end of the first joint. It was the intention to drill this plug out after the casing had been placed; but when about ½ mile of pipe had been lowered into the hole the pressure of the water was so great that the plug blew out with great force. After this happened a second plug was placed in the next section; this plug likewise was of wood, but it also had a steel ring back of it. When all the casing had been placed in the well this plug was drilled out leaving the casing free. When

you realize that this string of pipe 6,320 ft long with a weight of over 48 tons was to a great extent held by the last weld it will give you a very good idea of the strength of a properly made weld.

Before closing, I might say that we exercised great care in being sure that more metal was used at the weld than there was in the pipe itself. On this line we made it a point to have at least 1-10 in. more and on the casing sometimes more probably ⅛ to 3-16 in. The strength of the weld depends wholly upon the amount of metal used and the care taken in welding the two together.

ENGINEERING EXPLOSIVES

Nitro-glycerine is a limpid oil formed by the action of a mixture of nitric and sulphuric acid upon ordinary glycerine. This chemical action is a violent one unless carefully controlled. After it has taken place, the nitro-glycerine is washed repeatedly to remove any trace of acid that might remain. The presence of acid is dangerous in the finished explosive because it may produce a chemical action of disastrous results. For practical use, the liquid nitro-glycerine is so sensitive to percussion and friction that it is dangerous to transport it or attempt to employ it alone. However, when nitro-glycerine was first introduced for driving the Hoosac tunnel in Massachusetts, and for springing oil-wells in Pennsylvania, it was used alone, being carried in copper cans and loaded in tin tubes. In the oil-well region, men made an occupation of driving a horse and light wagon through the country for carrying the pure nitro-glycerine to the consumers. Many accidents were reported, and a carrier's position was scarcely to be envied.

Later it was learned to mix the nitro-glycerine with a quantity of kieselguhr, an infusorial earth composed of the silicious skeletons of minute diatoms, and therefore called diatomaceous earth. The nitro-glycerine is absorbed by the earth, which is itself inert and simply forms a plastic mass that can be more safely handled than the nitro-glycerine. Another advance came when it was found that nitro-cellulose, or gun-cotton, could be dissolved in the nitro-glycerine to form a nearly uniform jelly. This mixture constitutes blasting gelatine. The gun-cotton is made by the action upon cotton fibres of the same acids as are used in the manufacture of nitro-glycerine, great care being taken to wash away all trace of excess acid. When gun-cotton, or nitro-cellulose, is incorporated with the nitro-glycerine, it shares in the explosion, instead of acting as an inert base like kieselguhr. Thus additional power is gained. Blasting gelatine, then, is a mixture of two complex compounds, which fact increases the possibility of chemical change with consequent deterioration and danger. Blasting gelatine contains 92 per cent. nitro-glycerine and 8 per cent. nitro-cellulose There are, also, various intermediate mixtures of nitro-glycerine and nitro-cellulose with a proportion of wood meal and potassium nitrate, the object being to produce effects intermediate between straight dynamite and blasting gelatine. When such a complex mixture was attempted, it was at first difficult for any mechanical method to render a perfectly homogeneous mass, but later methods of manufacture have improved this.

The initial pressure of the different explosives when detonated in their own volume are as follows: straight dynamite (nitro-glycerine mixed with an inert base) 80 tons per square inch, blasting gelatine 113 tons, gun-cotton 71 tons, black powder 21 tons. It is evident that blasting gelatine is the most powerful. Likewise it has the highest rate of detonation, 25,-262 ft. per second, as against 22,368 for straight dynamite and 984 for black powder.—*Mining and Scientific Press.*

A PULMOTOR IMPROVEMENT

The Draeger Oxygen Apparatus Co., Pittsburgh, has developed a new valve for portable, hand-operated pulmotors which is said to control the air pressures producing inhalation or exhalation of the patient's lungs. The pressure control valve is in the hands of the operator, who is at the patient's head—not at the pump. The operator moves the lever back and forth to obtain uniform inhalation and exhalation, timing these with his own breathing. The man at the pump produces only the amount of air desired by the operator and maintains this by occasional strokes, as necessary. A pressure once obtained is maintained until the operator releases it. Indicating gages located near the valve show the first symptoms of the return of natural respiration to the patient and enable the operator to time his efforts with the patient's breathing.

INDUSTRIAL PREPAREDNESS AND THE ENGINEER

BY WILLIAM L. SAUNDERS

[The following is a small portion of an article with the above title which is the leading paper in Engineering Magazine for July.—Ed. C. A. M.]

Coal, iron, and factories, if organized and mobilized, are real sources of military supremacy, just as much so as they are the sources of industrial supremacy in peace. Just as the human element has had to give way in its effectiveness to machinery, so has the valor of the soldier taken second place in importance to the volume of munitions. The causes which brought about the change in both cases are identical; and it seems plain that it is mainly because the Allies have increased and standardized their capacity to supply munitions, and because they have had the aid of the industrial resources of the United States, thus bringing them to a point quite equal to the resources of Germany, that the present war promises to result in a draw. Were Germany fighting Russia and France alone, her preponderance of resources would have enabled her to crush them.

Having called attention to this situation, the natural question is, What is the remedy? Is it not plain that we need first an organized and centralized direction of our mines and industries? The government of the United States should not look to the ownership, but to the organization and direction and encouragement of these assets. It should stop waste by providing for cooperative work and even for combinations among all the natural resources of the country. Through proper supervision and direction, the owners of these natural resources should be permitted to make fair profits in the direction of efficient production and contrary to the scattered and now uncontrolled system of waste. The most valuable things which Nature has given us are in a disorganized condition, working at loose ends, operated with the objective in view of profit during the lifetime of the present generation only.

The question naturally arises: How shall this supervision and direction be accomplished? The answer is already given in the organization of the engineers of the country. At the request of the President of the United States, five National Engineering Societies, acting under the direction of the Naval Consulting Board, through its Committee on Industrial Preparedness, have organized boards of engineers in each state and territory. These engineers, who belong to and who have been selected by their respective societies, are at work now upon a plan of industrial preparedness. Here we have a board of five engineers in each state and territory; these men in turn have at their command all the members in good standing of these five societies, comprising more than thirty thousand engineers, who have been called upon as field aids. This professional, nonpartisan organization is unique in our history. Nothing like it has ever been known before. The usefulness of such an organization can scarcely be measured. It should be made permanent. Who but the engineer is qualified to do effective work looking to the conservation of our natural and industrial resources? The engineer is an executive through training and experience. It is he who has built up these great industrial resources, hence we are safe in asking him to take care of them. Engineering has been defined as the art of organizing and directing men and of controlling the works of Nature for the benefit of mankind. He works for reputation and results rather than for profit. His aim is to accomplish the best result in the most economical manner, for this is the best engineering. He is engaged in analyzing and putting to practical service the hidden forces of Nature.

Let the Government and the Congress take heed to the advice of this splendid body of professional engineers, and let them do something more than merely tabulate our industries. They should stand as a reliable body to bring Government and business closer together, not on special, but on broad, general lines. Through this organization let the politician and the business man cooperate for the present and future safety and prosperity of our industries and for that measure of peace in the nation, the enduring nature of which now passeth all understanding.

Forty-seven large manufacturing concerns at Oshkosh, Wis., on July 1 put into effect the "extra daylight" plan by permitting all employees to start and finish work an hour earlier. This is the sensible and proper way of doing it, much better than monkeying with the clocks of the whole community.

ARTIFICIAL ICE IN CANADA

An effective illustration of the progress which has been made in the economics of artificial ice manufacture is found in the fact that a large and long established Canadian firm, the Lake Simcoe Ice Company, of Toronto, can see prospective profit in the installation and operation, night and day, of an up to date ice producing plant. The company may be assumed to be fully informed as to the possibilities of profit in the undertaking, having been formed forty years ago and now harvesting natural ice in large quantities at Lake Simcoe.

The manufacturing plant is not intended to interfere with the supply of natural ice but is to be regarded as an auxiliary. With natural ice there are various losses or expenses involved, such as first handling and conveyance, breakage, melting and storage, which disappear or are much reduced when the ice is manufactured. The artificial ice also is perfectly and uniformly clear and pure and more readily marketable.

The plant has a capacity of 75 tons of ice per 24 hours and embodies all the devices known at the present time for producing ice of the best quality and at the lowest cost. The main unit of the plant is an 18 by 28 in. York vertical, single acting, belt driven, ommonia compressor, driven by a 200 h. p. Canadian Westinghouse, slip ring motor. The ice is frozen in galvanized iron molds surrounded by brine. Each mold is 11½ by 22½ in. by 60 in. deep, and will make a cake weighing 400 lb. The water for filling the cans is filtered and precooled, first by passing through coils of galvanized pipe covered with the waste ice from thawing, and later in a storage tank where it is cooled to 38 or 40 degrees before passing into the cans through the automatic can fillers.

COMPRESSED AIR TO MAKE THE ICE CLEAR.

Although only the purest filtered water is used in the plant, the ice can only be made transparent by keeping air blowing in the cans, and thus keeping the water in motion during the freezing process. This is accomplished by means of a small brass tube which passes down the side of the can and allows the air to blow in near the bottom. While the ice is freezing, this brass tube is connected to the air pipe in the framework of the floor by a rubber tube, which is disconnected when the ice is ready to be lifted out. A galvanized iron perforated plate called a grid is suspended about the level of the water in the cans, and as the ice freezes, it expands and the water rises above the grid a few inches, in which collects any sediment in the water thrown out in the freezing process. This portion of the ice cake above the grid is thrown away after thawing and the grid makes a perfectly square top to the cake and makes all cakes of a uniform height.

The air for this purpose is first taken through a hood from the outside atmosphere and passed through a "Gardner" 10 in. by 12 in. horizontal, double acting, air compressor, equipped with unloader device for maintaining forty pounds pressure. The compressor is driven by a 20 h. p. Canadian Westinghouse motor and discharges into an air receiver 5 ft. diameter by 18 ft. high. After leaving the receiver the moisture is removed from the compressed air, first by passing it through a double pipe cooler made of 2 in. and 3 in. pipe, then through a shell and coil brine cooler in which brine is circulated by means of a small centrifugal pump from the freezing tank. The cold dry air thus obtained then passes through a reducing valve which holds a constant pressure of about twenty-five pounds on the laterals and connections which distribute the air to the cans. This air system, which is of the highest importance for obtaining clear ice is equipped with, in addition to the unloader on the compressor and the automatic reducing valve, electrical alarm gages which give the operator ample warning in case any of the automatic devices fail to work

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THE UNIQUE LA BREA FOSSIL BEDS

G. Allen Hancock has given to the city of Los Angeles, Cal., thirty-two acres of La Brea ranch, the section in which excavations have been made for the past three years, provided the land be improved and a museum established. The La Brea beds have produced thousands of perfect skeletons of birds and quadrupeds that have inhabited this section for the past 200,000 years. It appeared as though the bones had been placed in the huge asphalt pits by hand so perfectly were they piled. In one small space sixteen imperial elephant skeletons were found.

AIR-LIFTS AT A CYANIDE PLANT

BY PAUL W. GABELEIN*

At the cyanide plant of the Baker Mines Co., Cornucopia, Ore., the pulp, both sands and slimes, is handled entirely by air-lifts. In the following brief description, two of the air-lifts are taken up in detail and illustrated, the first handling sands and the second slimes pulp.

The ore, after being crushed in stamps to 25-mesh, is classified in a duplex Dorr classifier, the sands being lifted by air to the leaching tanks and the slimes being treated in three Dorr agitators 20 ft. diameter and 16 ft. deep, three Dorr thickeners, and a Portland continuous filter. The plant has three air-lifts for pumping sands and slimes, and compressed air is also required for the operation of the Dorr agitators and the filter.

Compressed air is supplied by a Sullivan compressor, class WG3, belt-driven, size 14x12 in. This compressor is operated at 120 r.p.m., and at 5,000 ft. altitude has a capacity of 215 cu. ft. per min. Air is compressed to 15 lb., which is sufficient for the operation of the air-lift system. The power consumption under these conditions is 12.5 hp.

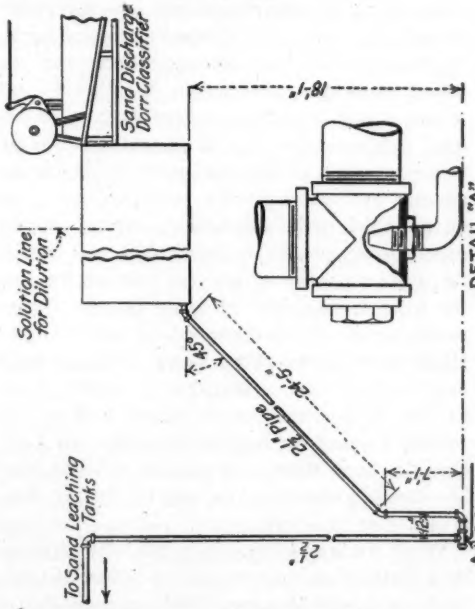


FIG. 1. DETAILS OF SAND LIFT.

*Mill superintendent, Baker Mines Co., Cornucopia, Ore.

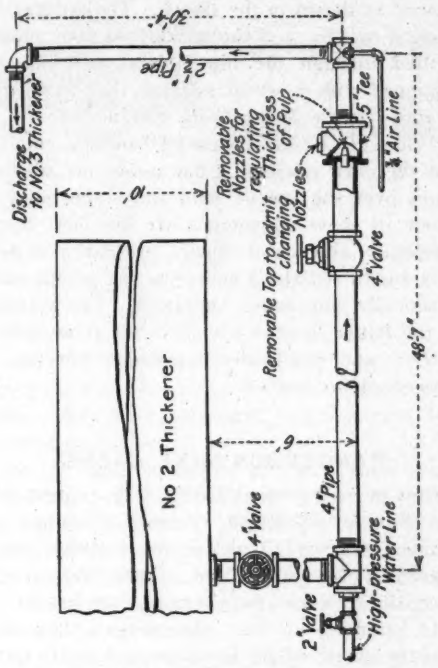


FIG. 2. AIR LIFT FOR SLIME THICKENER.

Fig. 1 illustrates the sands lift. As the sands are discharged from the Dorr classifier, they drop into a mixing box in which they are diluted with barren solution in the proportions of 4 of solution to 1 of sand. This rate of dilution has been found satisfactory both for the successful operation of the air-lift and the automatic distributors with which the leaching tanks are equipped. The sketch shows the construction of the lift in detail. The amount of sand handled per day is 40 tons, diluted with 160 tons of barren solution. Fig. 2 illustrates the air-lift between No. 2 and No. 3 thickeners. The situation of No. 2 thickener is such that it requires a rather long pipe line to transfer the pulp to a point from which it can be lifted to No. 3 thickener. The lift is rather a high one, owing to the fact that No. 3 thickener is at sufficient elevation to allow the pulp to flow by gravity to the filter-stock tank and thence to the filter. The slimes handled are very fine and colloidal. Fig. 2 gives the air-lift in elevation. It handles approximately 25 tons per day of slimes at a dilution ratio of 1:1, or 50 tons of pulp per day. The thickness of the pulp delivered by the thickener is regulated by placing nozzles of various sizes in a reducer

placed as shown in the sketch. The reducer is from 4 to 2 in., and the nozzles are 2-in. plugs drilled through the top. Each thickener is equipped with a set of nozzles, and these are changed as the flow of pulp demands.

While the air-lift system of handling pulp is not the most efficient, it has numerous advantages over the use of sand and slime pumps. Some of these advantages are low first cost, simplicity, absence of repairs, avoidance of delays due to repacking and repairing pumps and practically continuous operation. The system at the Baker Mines Co.'s plant has given satisfaction and practically continuous service.—*Eng. & Min. Journal.*

DANGEROUS MINE GASES

George A. Burrell and Alfred W. Ganger, of the Bureau of Mines, recently examined a number of Cripple Creek mines to gather data regarding the composition of gas that issues from the rock into the mines of that district.

In summing up their observations they say that the escape of gas from the rock strata into the mines of the Cripple Creek mining district is a menace to life and to mining. The outflow of this gas, supposed by Lindgren and Ransome of the Survey to represent the last exhalations of the extinct Cripple Creek volcano, is largely influenced by outside atmospheric pressure, because it is confined in the rocks under very low pressure.

At a few mines a pressure system of ventilation has been installed to assist the ordinary natural circulation. Under this system air is blown into the mines by a fan placed at the top of the shaft, thereby placing the mine workings under a little pressure, at some places equivalent to 6 or 7 ins. of water (about 0.5 in. of mercury). This method assists very materially in keeping the gas forced back in the rocks.

All told, 32 samples of mine gas were collected from four mines.

It was impossible to secure samples of pure rock-strata gas as it issued from the rocks during inspection of the mines, hence entrance was made as far as it was possible to penetrate into some of those drifts that were most contaminated with the gas. A sample containing 2.69 per cent. of oxygen (sample 760, Cresson mine) was obtained and was the sample containing the largest percentage of the rock-strata gas. Undoubtedly if one had been able to penetrate 15 or 20 ft. farther into the drift a sample practically devoid of oxygen would have been secured.

A number of samples that contained the smallest percentages of oxygen were recalculated air-free, in order to determine the actual composition of the gas as it issued from the rocks. This calculating showed that the gas contained between 12.03 and 18.37 per cent. of carbon dioxide and 81.63 and 87.97 per cent. nitrogen. The average of all the results was 13.87 per cent. of carbon dioxide and 86.13 per cent. nitrogen, or, in round numbers, 14 per cent. of carbon dioxide and 86 per cent. of nitrogen.

The gas, then, as it occurs in the rocks is a mixture of carbon dioxide and nitrogen with the latter much in excess.

The bad effects on life and lights are principally due to the fact that the rock gas so dilutes the air of the mines that the oxygen therein falls to a point where lights will not burn or so low that life is endangered.

Symptoms of distress in men do not usually begin to appear until 3 or 4 per cent. of carbon dioxide is present, when the breathing becomes affeceted. Men can go on working for a considerable time in such an atmosphere although they will certainly become more quickly fatigued. Carbon dioxide affects the so-called respiratory center in the brain and makes a man breathe a larger volume of air over a given time than if no carbon dioxide were present. While air with so small an amount of carbon dioxide as 2 per cent. may be breathed with comparative safety and no great discomfort, at the same time the efficiency of the workmen is lowered. In addition to the work a man may be doing in such an atmosphere he is handicapped to this extent: He is forced to breathe a larger volume of air over a given time, a feat that consumes energy just as his work of drilling a hole in the rock or loading ore consumes energy. In England the Coal Mines Act requires that the carbon dioxide shall not rise above 1.25 per cent. in any part of a mine.

When the oxygen in air is gradully reduced very little effect may be noticed before the occurrence of impairment of the senses and loss of power over the limbs. If the reduction is gradual and the symptoms carefully watched it will be noticed that at about 12 per cent. of oxygen (that is, with a reduction of about 9

per cent. from the composition of atmospheric air) the respirations become just perceptibly deeper and more frequent, and the lips slightly bluish. Distress increases with continued decrease of the oxygen until with 6 or 7 per cent. there is marked clouding of the senses and loss of power over the limbs, which would end sooner or later in death. In a test similar to the above that the senior author participated in, a man lost consciousness when the oxygen dropped to about 7 per cent.

As the oxygen in air decreases the illuminating power of lights diminishes, until in the case of the ordinary oil-fed lamp wick such as a candle or miner's oil torch or safety lamp, the flame becomes extinguished at about 17 per cent. of oxygen, and the acetylene flame at between 12 and 13 per cent. of oxygen, *i. e.*, if a candle flame goes out the oxygen content of the air is less than 17 per cent., and if the acetylene flame goes out the oxygen content is less than between 12 and 13 per cent. This effect is almost entirely due to the oxygen content and even in the Cripple Creek mines where the carbon dioxide may be from 5 to 10 per cent., in atmospheres that extinguish flames, it exerts only a minor effect.

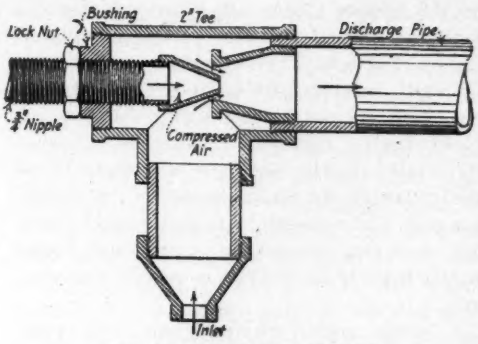
Men should not work where candles will not burn, and should not be solely reliant upon the acetylene flame for guidance regarding bad air. The acetylene flame will burn in air where the oxygen is only a few per cent. above the proportion that is very dangerous to life, hence only a small margin of safety is assured.

Eight of the samples contained traces (0.01 to 0.03 per cent.) of combustible gas, apparently methane (CH_4). The proportions were so small, however, as to be insignificant.

AIR SIPHON FOR CLEANING GAS RETORTS

BY H. C. MC DERMID

An unusual method was employed recently to remove brick dust and chips from a large bank of gas retorts. The device used was a roughly built vacuum cleaner operated by compressed air. As the diagram shows, it was made of a 2-in. tee with a portable bushing and ¾-in. pipe screwed in one end. The nipple on this pipe was threaded over its entire length of 6 in. and was drawn down to a small opening. This small end was reamed out to a smooth finish by a taper reamer, leaving an outlet



FOR CLEANING GAS RETORTS.

about ¼ in. in diameter. When its proper position had been determined this pipe was secured by a locknut.

At the opposite end of the tee a short 2-in. nipple was screwed in place, its inner end forming an orifice with inside diameter of 1 in. and about 1 in. from the end as shown. To the branch of the tee was screwed a short 2-in. nipple having a ¼-in. opening. The device is really an air siphon.

In practice the discharge pipe was used as a handle, its outer end being covered by a wet sack for collecting dust and flying chips. The collector pipe was 25 ft. long and for easy handling was balanced on a roller carried on a frame set in the mouth of the retort. The device was extremely satisfactory on the work upon which it was employed.—*Engineering News.*

MINE VENTILATION

BY CHARLES A. MITKE.*

At the Copper Queen mine, Bisbee, Arizona, the Spray, Gardner, Lowell, and Sacramento divisions are ventilated entirely by mechanical means. After the pressure and exhaust systems of ventilation were carefully studied, the former method was adopted. In this system all mine fans were placed underground on the deepest working levels of the different divisions so as to draw the air down the intake shafts, force it through the workings and stopes, and exhaust it to the surface through upcast shafts.

The reasons for adopting the pressure instead of the exhaust system are as follows:

1. More practical. Since all the deep shafts

*Abstract from Bulletin No. 105, American Institute of Mining Engineers.

of the Copper Queen are in operation and a large amount of work is done around each, as for example, men going on and coming off shift, handling timber, tools, and supplies, etc., it would not be practical to have an exhaust fan on the surface near the collar of the shaft. In the Gardiner, a subway below the collar of the shaft would be out of the question. Consequently a large air-tight chamber, inclosing nearly the entire head-frame, would have to be built if a suction fan were used.

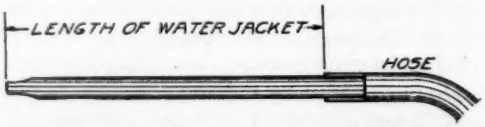
2. Better control of mine fires. The pressure system is the more advantageous in case of mine fires. With this arrangement, the entire workings are under pressure, and the gas or smoke from a mine fire may be coursed to exit through neighboring shafts that are not in operation. Since the air is under considerable pressure at the bottom and sides of the present fire districts and each of the outlets over them is provided with regulator doors, the quantity of air passing through the fire zone can be increased or diminished at will, and consequently the fire can be brought under control more readily than with the exhaust system.

3. Greater efficiency. Since the Spray, Gardner, Dallas, and Sacramento shafts are natural down-casts, the mine fans were placed underground so as to take advantage of these circumstances and multiply the volume of the natural down-case from five to ten times. The pressure system, therefore, has the advantage of the additional natural ventilation, which evidently would be lost with the other system; and more power would be required for the same quantity of air if the natural down-casts were changed to up-casts by suction fans.

4. Greater safety. Experience in the Lowell mine fire showed that in the event of the connections being closed between the fire and the suction fan, there is a possibility of smoke and gases entering the workings below and endangering the men. In the adopted system, the maximum air pressure is below the fire district, which makes it impossible for gases to go down, even if bulkheads of a sealed fire district should be opened suddenly by caving ground. At present a churn-drill hole is being put down to a depth of 1,100 ft. over the old Lowell fire stopes. When this is completed water will be run in to cool the area. No trouble is anticipated, since this was thoroughly tried at the Holbrook, where a large amount of water was turned into churn-drill holes, and no smoke or gases were taken down against the pressure of the mine fan.

ADVANTAGES OF NEW SYSTEM.

(1) A smaller quantity of compressed air is used for ventilation. (2) All possible natural ventilation is utilized, and the general direction of air currents is the same for both natural and mechanical ventilation. (3) There is a decrease in temperature, and a lower percentage of humidity and CO_2 throughout the mine, which means healthier working conditions. (4) A saving of eight 5-hp. blowers was made, as these have been removed from the mine. (5) The five lower divisions are under pressure, which partly acts as a check in preventing some mine fires from crossing the Copper Queen side-lines, as for example, the proximity of one mine fire near the Gardner workings. (6) Less decay of mine timbers. (7) The volume of air has been increased from 60 to about 300 cu. ft. of air per man per minute. (8) Formerly a large amount of moisture kept the timbers and working places in a damp condition, and fungus also covered most of the timbers. Since the mine fans were started, a large amount of water is removed daily from each division by the air currents, so that the mine is comparatively dry and the growth has disappeared. (9) The increase in velocity and volume of air resulted in the greater efficiency of the men. And (10) the new ventilating system is advantageous to the mines adjacent to the Copper Queen; there is a great deal of broken and stoped ground along side-lines, permitting a large amount of air to escape through these avenues and ventilated stopes beyond the Copper Queen boundary.



WASHING OUT COMPRESSOR WATER JACKETS

The cooling water used in the water jackets of air compressor cylinders is not always as clear as it should be, and as the circulation of the water is not rapid an excellent opportunity is afforded for the disposition of sediment and as a consequence the choking up of the pas-

sages is not infrequent. This matter is brought up in a recent letter by H. A. Jahnke in Practical Engineer. He says:

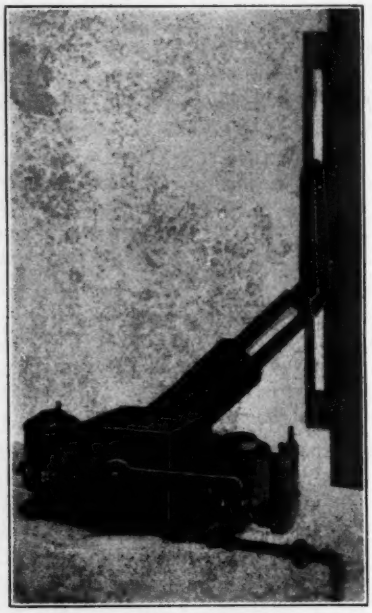
I believe the water jackets on some air compressors are not kept as clean as they should be. This is bad practice and may cause trouble some day. They should be inspected occasionally and washed out as often as found necessary instead of waiting until nearly all water space is clogged up with mud or other matter. I have found it a good idea, in washing out the water jacket to use a long nozzle made of ¼ or ½-in. pipe pointed at the end and as long as the water jacket, as shown in the illustration. In this way, the water space at the front head is much better cleaned of sediment and mud which accumulates there. With this nozzle you can play the water directly on the parts of the back head, which is not effected where a short nozzle is used. This arrangement is especially good where there is not much water pressure, as I have run water jackets which were nearly clogged up with mud, due to the fact that there was not water pressure enough to wash this out.

THE GREATEST TUNNEL IN THE WORLD

In spite of the heavy calls made upon her manhood in consequence of the war, France has not entirely given up civil engineering constructional work, and at the beginning of the month there was a formal celebration of the completion of one phase of a very important undertaking. This was the piercing of a tunnel which is to form part of a canal joining Marseilles with Arles, on the Rhone. The idea of connecting the great Mediterranean seaport with the vast systems of internal waterways which exist in France had been mooted for many years, but the present scheme was only finally adopted some twelve years ago. The length of the canal is to be 82 kiloms. (about 51 miles). The first five miles at the Marseilles end will be in the sea, though protected from it by a breakwater. The next 7266m. (say, 4.6 miles) will be entirely in a tunnel, which is being driven in a straight line under the Rove hills. On leaving the tunnel the canal will pass through a long cutting to near Marignane, from which place it will run along the southern shores of the lagoons of Bolmon and Berre as far as Martigues, where it will unite with the existing canal between that place and Porte de Bouc. That canal will be widened and deepened to meet the new requirements. From Port de Bouc to Arles it will make use of another existing canal, which will be entirely remodelled. It was the completion of the piercing of the tunnel portion which was celebrated on May 6th. The tunnel itself is driven in the solid rock, and its roof is to be lined inside to a radius of 12.503 m. At the towing path level it is 22 m. (72.18 ft.) wide, and as there is a towing path 2 m. wide on each side the width between the curbs of the towing paths is just over 59 ft. The minimum depth of water at the lowest tides is to be 3 m. (say, 9 ft. 10 in.). Its cross section rather than its length is the chief characteristic of this tunnel. In cross-sectional area it is approximately six times as large as an ordinary railway tunnel for two sets of lines. It will, when entirely completed, have necessitated the excavation of more material by far than any tunnel yet driven. The rock removed will be some 50 per cent. more than that taken from the two Simplon tunnels, and very nearly double that from the St. Gotthard. It is estimated that the canal will be in operation in another three years.—*The Engineer*, London.

"WAVE" POWER TRANSMISSION FOR ROCK DRILLS

Considerable interest has been aroused among engineers and mining men on the Rand regarding the application to rock drills of the newly-discovered method of transmitting power, known as wave transmission. A description of the principles of this novel system will not be available for publication until the formal introduction of the subject through the auspices of one of the London scientific societies. In the mean time practical developments are being pushed forward and within a few months underground trials of rock drills worked by wave transmission will be carried out on the Rand. Favourable arrangements have been made for this purpose with the Central Mining and Investment Corporation. Assuming these trials to reproduce the unique results obtained at the surface trials in London, the general adoption of the new system on the Rand should lead to an important reduction in mining costs.—*South African Mining Journal.*



DOOR OPERATING PNEUMATIC ENGINE

The halftone shows a pneumatic motor of a new type brought out by the Consolidated Car Heating Company for operating car doors. The control of the motor is electro-pneumatic by means of valves placed on each side of the engine. The air is cut off the engine at each end of the stroke. This economizes on the amount of air used as it eliminates all losses from leather leaks. At the same time it permits of atmospheric check or cushioning, which has proved to be the most reliable.

The engine has a safety feature which permits a small amount of pressure exerted by the passenger to hold up the door in case of premature closing. Further, the door may be pushed open 5 in. when fully shut to release clothing or anything that might be caught in the door. This is the limit of emergency opening, there being a positive stop to prevent a false opening. The engine is extremely light on account of its construction, the cylinders being of brass tubing. The arm, rack and pinion are made of cast steel. The engines are controlled by the standard Consolidated type push button for door control, which has been perfected for the past four years. Fifty equipments of these engines are being installed on cars of the New York Municipal Railway.

MINERS' PHTHISIS AN ANCIENT DISEASE

In a paper read by J. de Fenton, Ph.D., before a meeting of the Chemical, Metallurgical and Mining Society, it was shown that although miners' phthisis is commonly spoken of as quite a recent type of disease, it is in reality a sickness with a fairly long, if fragmentary, record. Pliny the Elder refers to respirators, and long before him Hippocrates, the Greek, spoke of the metal digger who breathed with difficulty and was of a pale, wan complexion. But it is not till we reach the days of Agricola, as Dr. de Fenton tells us, that we get what may be called a real practical diagnosis of miners' phthisis. There is no question of the identity of the disease, as Agricola studied it nearly four hundred years ago in Bohemia and as it prevails to-day in the mines of the Rand and elsewhere. For this reason the description of it in Agricola's famous book, "De Re Metallica," is of special interest to us. Until four years ago no translation of the work into the English tongue appears to have been made; but in the year 1912 one was published by Mr. and Mrs. Hoover. Since it became necessary to study what Agricola actually had to say with regard to miners' phthisis, a careful comparison of the translation with the original work was made, with the result, we learn that the former leaves something to be desired. It was mainly from this point of view of accuracy that Dr. de Fenton dealt with the matter in hand, and with his exceptional and wide knowledge of grammatical construction and word values in Latin it is not to be surprised at that he established a strong case against certain renderings of Mr. and Mrs. Hoover. The translators state it to be one of the three objectives in a work of this kind "to give a faithful, literal translation of the author's statements." The following extract relating to phthisis may be taken as an example of rendering into English to which Dr. de Fenton rightly takes exception. Mining is said to be a perilous occupation because, amongst other reasons, "metallorum fossores . . . haurientes pulverem pulmones exulcerantem, macie extabescant." The Hoover translation says briefly for this: "their lungs rot away," which is quite unsatisfactory from a medical no less than from a literary point of view.—*South African Mining Journal.*

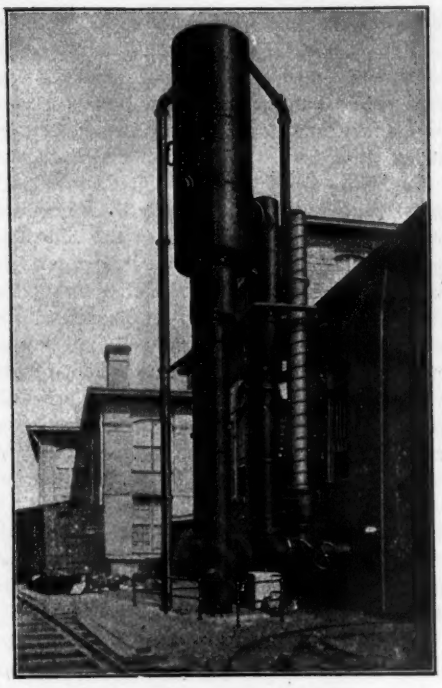


FIG I.

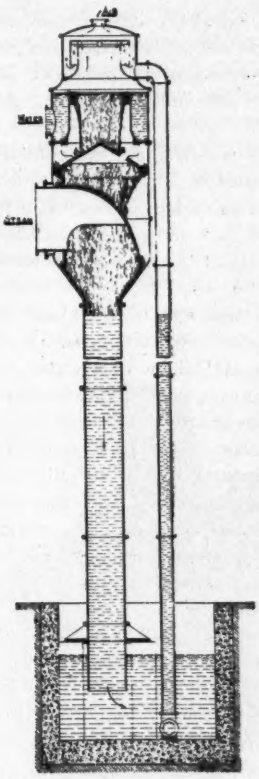


FIG. 2.

THE BEYER BAROMETRIC CONDENSER

The Ingersoll-Rand Company is now offering to the trade complete steam condensing plants for all service conditions. The equipment includes the Beyer Barometric Condenser, for which the company has secured the patent rights, Imperial duplex and Ingersoll-Rogler straight line, reciprocating, dry vacuum pumps and, where required, Cameron simplex and centrifugal pumps.

The Beyer Barometric Condenser is of the counter-current type, in which air and cooling water flow in opposite directions. The steam inlet is at the bottom of the condensing vessel, the water inlet above and the air removal opening at the top. The sheets of cooling water overflowing the pool at the inlet point meet the entering steam. The two are brought into intimate contact by conical baffle plates, thus assisting the water to absorb to its full capacity the latent heat of the steam. The non-condensable air liberated in the condensing action rises through the falling water to the removal point at the top. It is to be noted also that ample opportunity is given for the removal of the air content of the water before it mixes with the steam. This, the manufacturer points out, not only facilitates the mixing process but permits the removal of air and vapor at a comparatively low temperature, a distinct advantage as the reduction of volume saves in vacuum pumpage horse power.

The steam inlet is of large diameter to secure low velocity, and is hooded in such a way as to discharge the steam into the center of the condensing vessel. The air removal opening is also of ample area and is protected by a self-draining baffle and trap. This, it is said, positively prevents water being carried over into the vacuum pump.

The hot waste water is discharged through the self-draining tail pipe. This pipe straddles the hot well and rigidly supports the condenser.

VACUUM PUMPS

The Imperial and the Ingersoll-Rogler Vac uum Pumps are of the manufacturers' standard type. They are high-speed reciprocating

machines, wholly enclosed, automatically lubricated and are said to effect a floor space saving approximating 50 per cent. over that of the more common, slower speed vacuum pumps.

When a water pump is required to elevate cooling water to the condenser head Cameron pumps are provided. These may be either reciprocating or centrifugal as desired. The Ingersoll-Rand Company, however, emphasizes the fact that, where the level of the cold well is of sufficient height above the hot well, the condenser will lift its own cooling water, dispensing entirely with a water pump.

The manufacturer in presenting this equipment brings out the point that the vacuum and water pumps, being independently operated, can be regulated to suit varying water temperatures and conditions, and that this plant, in addition to its efficiency in general service, is admirably adapted for duty as a central condensing unit serving a number of prime movers.

TWELVE YEARS PROGRESS IN ROCK DRILLING

BY H. P. GILLETTE

Some branches of civil engineering work have experienced remarkable changes during the past decade, notably road building. Other branches have changed relatively little. The art of rock excavation falls among the latter. In rewriting a book that was published 12 years ago the editor was struck by the fact that nearly every fact that he had given in the original edition is still pertinent. It is true that many additional facts are now available, but they serve, in the main, either to reinforce conclusions established 12 years ago or to give greater details under a greater variety of conditions than were then available.

The two most important innovations in rock excavation that have occurred during the last generation are the use of the cable drill for deep holes and the pneumatic hammer drill for shallow holes. But each of these types of drill had begun to be used fully thirteen years ago.

The cable drill, originally developed for well drilling, was first used for blast hole drilling in 1913 and its use was first described by the editor who was at that time on the staff of another engineering paper.

To a superintendent who had used well drills the thought occurred that the same type of drill would be economic on railroad grading. His employer, however, could see no merit in a cumbersome well drill for such purpose and would not permit him to experiment. However, when the contractor's back was turned, the superintendent rented a well drill and began using it for drilling blast holes. It was a pronounced success, but the contractor was so exasperated at having his orders disobeyed that he "fired" his inventive superintendent without waiting for excuses. But when he discovered that the well drill had not only greatly reduced the cost per foot of drill hole but had made it possible to space holes farther apart, he sent for the discharged foreman, and, according to unverified rumor, remarked: "The Bible says fools rush in where angels fear to tread, so I guess I needn't be backward in taking off my hat to a man who was a big enough fool to think of using a well driller on a railroad cut. You've struck oil on this job and your salary will be doubled."

Who the man was that thought of using a pneumatic riveter for drilling rock, history fails to mention. Probably its first use was in drilling plug and feather holes. At any rate the editor first saw the "air hammer" used in a Massachusetts granite quarry for that purpose. Subsequently this type of drill began to be used in mining, where it speedily gained popularity and coincidently grew in size.

Another innovation that dates back less than ten years is the "wagon-mounted percussive drill," which consisted of a truck (often self-propelling) carrying a percussive or piston drill mounted so that it can be raised and lowered bodily in "gins" or "leads" (similar to those of a pile driver), mounted on a turntable. Doubtless this design was suggested by the mounting of subaqueous drills in "leads" on scows. Where the rock surface is comparatively level the wagon-mounted drill is apparently destined to grow in popularity. As stated in our issue of May 24 one of these wagon-mounted drills averaged 200 ft. of hole per 10 hr. day for 2½ years on the Sag Channel of the Chicago Drainage Canal, the holes being 3½ in. diameter and about 12 ft. deep in limestone. Such a remarkable achievment would be impossible with a tripod drill because of the large percentage of time lost in shifting from hole to hole and in the more frequent changing of bits required where the entire drill machine

can not be raised and lowered bodily in "leads." In Gillette's "Rock Excavation" the best long-time record of tripod drilling on the Chicago Drainage Canal was 82 ft. of hole per 10 hr. shift, holes being 12 ft. deep and 2 in. diameter at the top. This, it will be noted, is only 40 per cent as much footage (with a smaller hole) as has been averaged in the same rock with wagon-mounted drill above referred to.

The mounting of a drill on trucks of course permits the use of a larger machine, and this, in turn, makes it possible to drill holes of greater diameter and of considerable depth. Holes 4 in. diameter at the bottom and 30 ft. or more deep can thus be drilled economically. With deep holes of large diameter the spacing of the holes can be made greater.

A water jet to keep the bottom of a drill hole clean is not a new device, but it has come more and more to be recognized as a very effective means of increasing the footage drilled in a given time. Still, there are hundreds of contractors and superintendents of rock work who have yet to learn the merit of this simple expedient, particularly as applied to rock that chips off in comparatively large fragments under the blows of the bit. The larger the chips and the bigger the hole the greater must be the volume of water forced into the hole through the jet pipe, in order to lift the chips out of the hole. If the rock chips are not removed as rapidly as they are made, the drill spends much of its time acting as a pestle pulverizing them, instead of breaking off new fragments of rock.

Percussive electric drills and gasolene drills have, as yet, not come into general use. Electricity is readily transmitted at small cost; gasoline makes each drill its own power plant. Yet the difficulties that attend the use of electricity and gasoline in rock drilling are so great that these two sources of energy have been slow of adoption for this purpose.

Rock augers have been successfully used in tunnels and other underground work where the rock was soft. It is not beyond the range of possibility that during the next ten years the auger type of drill will be extensively used in open cut work where shale and other soft rocks are encountered. In the California oil fields the auger type of well drill has grown in popularity. Those who contemplate drilling blast holes with augers will do well to study this type of drill as used in well drilling. It seems to be especially adapted for boring holes of very large diameter, and for that reason its use may prove economic even where the cost per foot of hole is high. Large holes heavily charged with explosives may be spaced far apart, and thus effect a low drilling cost per cubic yard of rock.

In general there has been a growing tendency in open cut work to drill holes of larger diameter. We believe that we have by no means reached the economic limit in large blast holes.—*Engineering and Contracting.*

SAND BLASTING GLOVE

The striking half-tone above which has such a warlike look is taken from a glove of novel type which has been developed by the Hickory Steel-Grip Glove Company, Chicago, for the use of sand blast workers. It is a rather complicated production, being made of chrome tanned horsehide reinforced with strips of napa leather which are fastened to the horsehide with small steel ribbons clinched on the inside in a layer of canton flannel. This covers the

sharp edges and prevents them from scratching the hand. All the seams are stitched with fine steel wire and no cotton or linen thread is used on the wearing surface. The thumb is placed on the side seam so that the glove may be worn on either hand and the gloves may be bought either by the pair or singly. The reversible feature enables the wear of the glove to be equalized on the two sides. A heavy gauntlet protects the wrist and extra reinforcement is provided at the thumb seam.

THRILLING EXPERIENCE AND NARROW ESCAPE OF A DIVER

Seattle, Wash., July 2.—Rescued from the bottom of Elliott Bay at Smith Cove, after he had been fifty feet below the surface for five hours and forty minutes, A. Verbeck, 49, a deep sea diver, was revived and has a chance for life after being long given up for dead.

Verbeck was imprisoned at the bottom when ropes attached to his diving suit became entangled among some steel rails which he was working to enclose in a sling in order to raise them to the surface. The diver was on the floor of the bay from 7 P. M. until 12.40 A. M., when rescuers who had been working for several hours managed to bring him to the surface.

The rescue party had long before given up all hope of saving Verbeck's life. Their surprise was only equalled by their joy when they found that the supposed corpse was still breathing, and in a few seconds it was found that Verbeck was not even unconscious, never having been completely overcome during all the hours below.

The diver is a man of powerful physique, to which is attributed his marvellous resistance. Other divers and men familiar with this sort of work said that three hours was supposed to be the maximum at which a man could live at the depth to which Verbeck descended.

Verbeck was at the bottom for about an hour and a quarter before the accident occurred. He had already fastened the lines around three rails, which were brought to the dock. Suddenly several men who had been pumping air to the diver failed to obtain any response to their signals. They at first thought there was something wrong with the signal, but later, when there appeared to be no signs of activity at the bottom of the bay, they decided to investigate.

Henry Finch, another deep sea diver, was taken to the dock in an automobile and he immediately went into the water. Within a few minutes he returned with the word that Verbeck was probably dead. Finch said that the lines fastened around Verbeck's body had evidently become entangled in the rails. The diver was imprisoned under one of the rails and he was buried deep in the sand at the bottom of the bay. A physician was called and a pulmotor and ambulance were rushed to the scene, but the rescuers were unable to release Verbeck for more than two hours.

INDUSTRIAL DESICCATION

An industry that is sure to be developed in the near future is the drying of agricultural products, such as potatoes, and also aqueous industrial residues, such as come from sugar making and from breweries. In France the process is now applied for drying fresh beets, and there are also three beet sugar works which employ it for the drying of the exhausted pulp. In the north of France there is now being worked an industrial process for making "sugar flour" from fresh beet pulp, and a desiccator is employed here in the shape of a tower into the top of which the pulp is poured, and it comes in contact with warm air; then the pulp is delivered by a rotary device on a set of superposed gratings, where it receives hot air, commencing at a lower temperature and afterward using warmer air up to a temperature of 120 deg. C. (248F.) Such dried beet pulp produces a flour which has the sweetening property of sugar to a certain extent, and could be used in all cases where the sugar is not required to be pure, such as in breweries, for special breads, for feeding stock, and the like. A ton of beets gives over 500 pounds of flour, which sells here for $2 the hundredweight. Its composition is: Albumens, 6 per cent; saccharose, 66; carbohydrates, 13; cellulose, 5; water, 6; miscellaneous, 4 per cent. Following the success of the present methods, it is thought that other industrial drying processes will be invented which will, for instance, enable stock to be fed on dried potatoes, as these are so difficult to keep in the usual state. Damp grains harvested in bad years also can be dried. Apparatus like this could use waste heat from factories.

UNDERCUTTING WITH A RADIALAXE.

COMPRESSED-AIR COAL CUTTERS IN CANADIAN MINES

BY S. W. SYMONS.

In the bituminous mines of western Canada the compressed-air column-mounted coal cutters of the Radialaxe type have made a reputation for themselves owing to their low cost of upkeep and operation. One of the largest mines using Radialaxe machines is that of the Dominion Coal Co. at Cape Breton. These cutters are for the most part being operated in what is known as the Phalen seam, which is about 6 ft. high and almost level.

The rooms average about 20 ft. wide and are undercut by the Radialaxe machines to the full depth of 5 ft. 6 in. or 6 ft., and the coal is brought down by the three-hole system. One hole, known as the plug hole, is placed about the center of the room, 4 ft. from the bottom, and another is drilled at each corner of the room about a foot from the rib and the same distance from the roof. The center, or plug, hole is shot first, and the two corner holes are shot together.

The amount of coal that the machine will cut of course varies with local conditions, depending on the hardness of the coal, the presence of sulphur balls, the condition of the roof, bottom, etc. At the Dominion Coal Co.'s mine the machines cut from five to ten rooms per shift. The coal is all cut by contract, the machine miner being paid by the ton and paying his own helper, so it is rather difficult to arrive at the maximum capacity of the machines. The machine runner makes anywhere from $8 to $15 per day clear of expenses, and with comparatively light work. If he has good luck and good air pressure, he may get ten rooms finished in five or six hours.

In a test recently conducted between an air-driven shortwall chain machine and the Radialaxe (Ingersoll-Rand No. 37 Type), the former cut 46 rooms 30 ft. wide in 16 shifts and the Radialaxe cut 84 rooms 30 ft. wide in the same time.

This company submits an interesting report on the cost of upkeep on the 300 Radialaxe machines they have had in operation during the last two years. The machines were originally purchased during the years 1911, 1912

and 1913, and represented an intial outlay of something like $50,000. They have seen continuous service ever since.

The cost of repairs was taken on three different occasions—the first time in the Lingan district only, covering the operation of 200 machines for a period of six months, the average cost per machine per month being $1.50.

The second cost was taken about a year later and covered the total number of machines that had run for the period of one year. This showed the cost of repair to be $1.35 per machine per month.

The third cost has only just been completed and covered a period of one year on the 300 machines now in operation. This showed a repair cost of $1.34 per machine per month.

The majority of these machines are four or five years old, while a few are three and some two years old.

The construction of the Radialaxe follows, in general, standard rock-drill practice, having been developed from the old-time piston drill. The drill proper is a long-stroke type, the maximum stroke being 10 in., controlled by a combination tappet and air-thrown valve which allows a variation in the length. The drill is mounted on a shell having a feed of 20 in., and the whole is mounted on a column that allows of swinging the bit radially in either a horizontal or a vertical plane. This swing mechanism is operated by worm gearing controlled by the operator and can be placed in any position on the column.

The machine is built entirely of steel so as to make it as light as possible and provide for easy handling. At 80 lb. air pressure it is capable of striking 600 blows a minute, and the air consumption is approximately 150 to 200 cu. ft. per min.—*Coal Age.*

Finely powdered aluminum forms a part of two of the most destructive explosives known, one of which, ammorial, is a mixture of five to eight parts of ammonium nitrate with one part of the aluminum powder, and is used to charge shells. It is one of the few explosives which presumably can never be used as a propellant, as its action is so sudden and the force so tremendous that no gun yet dreamed of would be able to stand it.

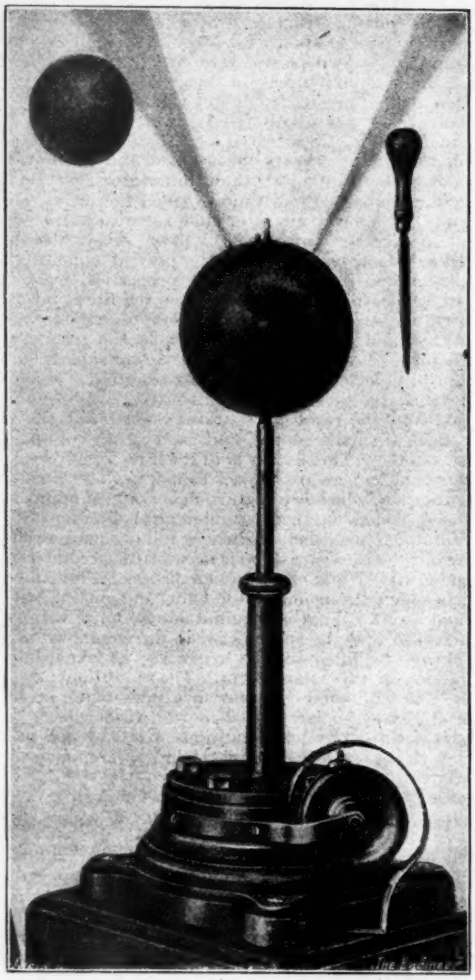


FIG I.

THEORY OF THE BRASHER AIR BREAKWATER

The Brasher Air Breakwater, which has more than once been brought to the attention of the readers of Compressed Air Magazine, was recently described and illustrated in the pages of *The Engineer* of London, and the following letter, which requires no comment, appeared later in that publication. The matter would seem to deserve still more thought and discussion.

THE BRASHER AIR BREAKWATER.

SIR—In your issue of May 19th last, pages 414-415, you have a most interesting article on

the Brasher air breakwater, and as the propagation of waves has been of some interest and study to me, I would like to suggest to Mr. Brasher that the theory on which he has originated his breakwater has a simpler basis than that offered in the article—at least, if my theory of wave action is fairly correct. The theory I put forward is based on certain experiments which I hereinafter describe, as well as on the known effects of air currents on aeronautic planes. It may possibly therefore have some general interest, and perhaps Mr. Brasher may desire to make further investigations on the lines indicated.

My theory is that a current of air of sufficient velocity, passing over a rounded surface, causes a slight increase of pressure above atmosphere on the windward side, and a reduction of pressure below atmosphere on the leeward side. As an illustration of this theory, I send a photograph, Fig. 1, of an apparatus, by which it has been demonstrated that a ball or an ordinary 8-in. file can be supported in the air if a jet of air of sufficient velocity is passed over the rounded surface of the ball or the rounded end of the handle of the file. It would appear that the velocity of the jet passing over the rounded surface increases the pressure of the atmosphere slightly on the rounded surface towards the jet, and reduces the pressure on the opposite side below that of the atmosphere, so that the file or ball is held up to the jet by the pressure of the atmosphere. That the support afforded by these air jets is of some magnitude is proved by revolving the ball of the apparatus, which, being fed from the source of the air supply through the stem, forms a small reservoir for the jets or nozzles inserted in the ball. When the ball is revolved, which is done by the small air-driven wheel at the bottom of the stand, the articles supported in the air revolve with the jets, and a considerable pull on the end of the file is necessary to detach it from its support on the jet. To obtain the support of the jet the rounded surface of the ball or handle of the file must be approached gently to the lower surface of the jet, and must not enter the jet itself. The above explanation is given in order to illustrate my theory of the action of the wind on the surface of the water shown on the accompanying diagram, Fig. 2, which explains itself. This diagram suggests that waves have a difference of atmospheric pressure on their two sides caused by the velocity of the wind over their rounded crests.

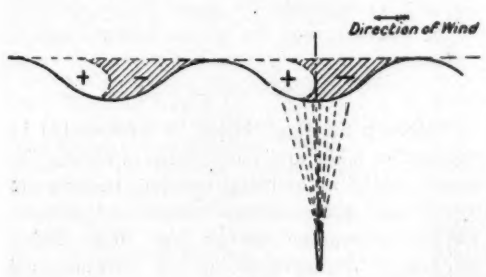


FIG. 2.

By Mr. Brasher's breakwater this difference of atmospheric pressure caused in the troughs between the waves by the velocity of the wind passing over their crests is neutralized by the admission of air above atmospheric pressure, which is delivered into that space by the jets of the breakwater from below the surface of the water and below the current of air passing over the crests of the waves. In this way the rise and advance of the waves is mechanically checked.

M. INST, C. E.

May 31st.

ADVANTAGE OF SANDBLASTING FORGINGS

BY W. C. LYTLE.

The question of removing the scale has demanded the attention of manufacturers for years and many methods such as pickling, tumbling, buffing, polishing and electrolytic cleaning, have been tried with more or less uniformly *unsatisfactory* results.

Probably the most common of methods is pickling. Forgings are pickled in a solution of sulphuric acid and water to remove the oxide scale which forms during cooling.

After forgings are removed from the pickling tank it is necessary to wash them in a hot solution of potash or soda to neutralize the acid remaining on forgings; they, also, must be thoroughly washed in hot water, which must be frequently renewed or it will become impregnated with the acid.

Often, due to careless washing or to rushing the work through too quickly, forgings are not washed free from all acid. If these forgings are immediately put through any machining operation the acid remaining on the forgings very quickly destroys the edge of the cutting tool, and a lot of time is unavoidably wasted in

resharpening. If forgings are not used immediately, they rust very quickly due to the acid. The vapor given off by a pickle solution is very injurious to the machinery or anything metallic, rusting everything it reaches. Operators suffer from acid fumes and very frequently from acid burns. Forgings that have been sand blast cleaned do not injure tools or the hands of men that handle them, and if put in bins do not rust nearly so quickly as pickled forgings, nor is the rust so deep.

The advent of sand blasting heralded a new era in the manufacture of drop forgings. First we find it done by hand, developing in a short time to an art which has reduced the once very difficult problem of removing scale to a very simple operation.

The mechanical cleaning of scale from the forgings with modern sand blast equipment, barrels and tables, does away with all slop, fumes and bother of the pickling department.

In these days of "Safety First" when provision for the safety and comfort of the employe has proven a paying investment, the advantages of the sand blast as compared with the pickling vat are at once apparent. The former is as comfortable to operate as any other machine in the shop and absolutely no menace to other equipment.

The first type in general use was the hose sand blast, and where there are varied classes of work with not enough of any one class to warrant the expense of special equipment to handle same, the hose and blast is still a general favorite because of its flexibility.

In the Packard plant, Detroit, Mich., two types of these sand blast machines are in use, the barrel and table type. The table type consists of a circular grated disc of any desired size revolving horizontal with the work resting on it. By means of compressed air (preferably at 80 lbs. pressure or more) abrasive is discharged through one or more nozzles upon the work resting on the disc. By this arrangement the work is blasted on the upper side, which when completed is turned down to allow the work to be blasted on the opposite side. A bona fide example of the capacity of this type of sand blast is 60 crank shafts and 200 connecting rods in one hour. Discounting this 10 per cent. for continuous operation would show a daily (10 hours) capacity of 540 crank shafts and 1,800 connecting rods. The barrel type is equally as efficient as the table type, but its scope of work is different in that it is adapted more for small or medium sized parts of more or less irregular design. In construction it consists of a revolving barrel inside of which are placed nozzles at different angles so as to distribute the blast very uniformly and also to blast all sides at the same time. The nozzles are all adjustable to any angle with relation to position occupied by the work in the revolving drum.

The cabinet type is limited to small forgings of a size convenient to handle, and is especially adapted to plants where large capacity is not required, or where the work is delicate and must be handled carefully.

With all types, satisfactory ventilation and arresting of the dust, is accomplished by means of exhausters of suitable design, and contrifugal or screen type dust arresters. The former type of arresters are adaptable to plants where it is the desire to prevent diffusion of dust in the room where the equipment is located, and where it would not be objectionable to discharge a small amount—not more than 5 per cent. into the atmosphere. With the latter type, the dust is entirely suppressed and the purified air returned to the room from which it was drawn, instead of discharging into the atmosphere. This is a decided advantage and economy in winter, as the necessity of continually warming incoming cold air is avoided.

That oldest scientific bureau of the U. S. government—the Coast and Geodetic Survey—celebrated on April 5 and 6 the one hundredth anniversary of the beginning of its work of surveying and charting our shores. This bureau was established by that most talented and versatile of American statesmen, Thomas Jefferson, who was great not only as a statesman and a patriot, but as a philosopher, a scientist, a musician, a linguist, a diplomatist, an educator and an architect. A noted Swiss scientist, F. R. Hassler, was the bureau's first superintendent.

Although St. Paul, Minn., is surrounded by spring-fed lakes and has the finest natural ice in the world, an artificial ice plant turning out 30,000 tons per year has been found to be a paying enterprise during the first twelve months of its operation by the Citizens Fuel and Ice Co.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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THE SUBAQUEOUS TUNNEL RECORD

On page 8056 of our July issue a small item called attention to the record made in driving the Dorchester Rapid Transit tunnels under Fort Point Channel, Boston, the greatest monthly advance being 375 ft. The data of the work was given in greater detail in *Engineering News*, and the record claim is challenged in the following letter to that publication. It will be seen, as the writer of the letter says, that the records are not at all comparable on account of the great difference in materials and methods. The suggestion of comparison on the basis of material removed "or displaced" seems to offer no satisfactory conclusion any more than before. The letter referred to is as follows:

Sir—Referring to the article in your issue of June 1, entitled "Subaqueous Tunnel Record," in which it is stated that claims have been made that the progress in driving the Dorchester Rapid Transit tunnels under the Fort Point Channel, Boston, Mass., established a record for subaqueous tunnel driving, I beg to call your attention to the following records of progress made in constructing the tunnels under the North River for the Pennsylvania R. R. and Hudson & Manhattan R. R.; Charles M. Jacobs, of this firm, being chief engineer for both projects.

The best progress made on the North River tunnels of the Pennsylvania R. R. was in the month of June, 1906, when the North tunnel, driving from Manhattan, made 545.2 feet.

On the Hudson & Manhattan tunnels, the best progress was as follows: North tunnel, Downtown System—the progress for 3 mo., from Apr. 30, 1906, to July 31, 1906, was 2,321.5 ft. The best progress for a month was in this tunnel, in July, 1906, when 967.5 ft. was made.

The best progress for a week was in the South tunnel, from Aug. 8 to 15, 1906, when 308 ft. was constructed. The best progress for one day was on Aug. 1, 1906, when 36 rings, two feet long, were erected, making 72 ft. of tunnel for the day.

Conditions are so different in various localities that no camparison that means anything can be made. In the case of tunneling in the Hudson River silt in the vicinity of

New York, the tunnels were advanced by forcing the shield through the silt without any excavating in advance of the diaphragm, and by only admitting through the shield doors a small portion of the material displaced by the shield.

Perhaps a fairer comparison of work accomplished would be had on the basis of volume of material removed or displaced in constructing a tunnel in a given time.

JACOBS & DAVIES, INC.,
George D. Snyder, Director.

30 Church St., New York City, June 6, 1916.

THE DOVER STRAIT TUNNEL

The great world-war in which by the irony of fate our most civilized nations are engaged stirs thought and discussion anew as to the desirability of the long planned channel tunnel to connect England and France. If such a tunnel had been completed and in service before the war began it apparently would have been of great service to the allies, and, as it has turned out thus far, there would have been no difficulty, we may believe, in guarding it and maintaining it in constant operation, although it must not be lost sight of that a charge or two of high explosives placed by experts could very quickly put it out of use and perhaps flood it so that it could not be brought into service again for years, if ever, and there are daredevils enough who would quickly risk their lives upon such a scheme. If there were an insurance company big enough to insure the tunnel against the war risk it would be interesting to know what the rate would be.

Professor Alglave of the law faculty of the Corbonne has been giving out some speculative computations as to the tunnel possibilities. It could have been built, it is said, for the cost to England and France of four days of the war, say 400,000,000 francs. To have symmetrical figures let us say $100,000,000. It would have permitted the transportation of 122 trains of troops in a day from England to France, and 60,000 tons of freight per day. Prof. Algrave contends that the enterprise if begun at the outbreak of the war could have been carried to completion before the end of the conflict, which is assuming either rapid tunneling or wofully prolonged fighting. Since comparatively few men would be required or could be employed on the work why not begin on it at once? While there were many in doubt as to the outcome of our Civil War the dome of the capitol was carried to completion.

SERIOUS ACCIDENT IN DRIVING A BOSTON TUNNEL

What is known as the L Street, South Boston, bridge tunnel which is being driven by the pneumatic process was the scene of a disastrous and fatal blowout on June 24. The tunnel is being built as an electric cable conduit under the Reserved Channel from two shafts 984 ft. apart. It is a 7 ft. circular tube 70 ft. below the water surface. Preliminary borings had shown the usual harbor silt, coarse sand and gravel, silt and sand, stiff blue clay and finally a hard stratum of sand, gravel and clay through which the tunnel was being driven. The shaft was sunk to a depth of 80 ft. as a steel caisson, using compressed air and reaching a maximum air pressure of 30 lb. Excavation for the horizontal tunnel had been carried but a short distance when the accident occurred. Four men had just entered the heading and they were carried out by the blowout, their bodies not having been recovered, and the inrushing water nearly filled the shaft. The tunnel walls are 12 in. thick and the shaft walls 16 in. thick. Accounts are not clear, but there seems to have been a general collapse of the shaft with displacement of the air lock rather than merely a blowout at the heading.

TECHNOLOGY OF MARBLE QUARRYING

The above is the title of a bulletin just issued by the Bureau of Mines of the Department of the Interior, Oliver Bowles, quarry technologist, being the author.

The aim of this bulletin is to present to the marble workers of the United States a concise statement of the most efficient and economical methods now in use for producing and preparing marble. The bulletin refers chiefly to the methods employed in the quarrying of marble and the conditions that affect successful operation; the structure of marble and its relation to quarry processes; waste through rock imperfections and inefficient quarry methods; and means of eliminating such waste or utilizing it if elimination is impossible.

"Perhaps the most important feature of the bulletin," said Van. H. Manning, Director of

the Bureau of Mines, "is the pointing out of a method for relieving earth pressure in certain quarries particularly subjected to natural strains. During the process of quarrying, this strain is relieved locally and the expanding rock breaks up into irregular masses, the fractures often being accompanied by loud reports. A method of avoiding excessive waste due to the production of these irregular fragments is described. It is advised that rows of deep, closely spaced, vertical drill holes be projected in a line across the quarry in such a manner that the rock may expand and partially close the drill holes, thus giving relief from strain without the destructive fracturing. One Tennessee marble company has already tried this method and has thereby greatly reduced the proportion of waste marble, and thus effected a saving of several thousand dollars. It is believed that several valuable quarries which have during recent years been abandoned on account of excessive strain breaks could be reopened and worked profitably if the methods proposed in this bulletin were adopted."

Copies of this publication may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C.

A NEW OXYGEN AND NITROGEN COMPANY

The Air Reduction Company, 50 Broad street, New York, recently incorporated with a capital stock of $2,500,000, has acquired the American rights to the Claude process for making liquid air for separating the oxygen and nitrogen of the air. The company has purchased control of the Superior Oxygen Company, which is the second largest producer in the country, and will operate the plants of the Superior Company. Six new plants to use the Claude process will be finished and in operation in five months and inside of a year the company expects to have plants all over the country. When all of these new plants are completed the new company will be the largest producer of oxygen in the world.

It is stated that the company will concentrate its efforts first on oxygen, which is a big field, especially in oxy-acetylene use. The company has engineers in Europe investigating the calcium carbide situation with a view to manufacturing this commodity, probably in Europe, for making acetylene for use in the oxy-acetylene burner for welding and cutting. The company may also make compressed acetylene, if they take up the carbide manufacture.

Another important field which the company will enter, after having the oxygen business thoroughly organized, is the production of nitrogen, cyanamid, ammonia nitrates and nitric acid. Two or three processes for making nitric acid are being tried out at the present time and the experiments are well under way. The South is a big field for fertilizer and the company expects to establish nitrate manufacture in the South either by one central plant or several distributed plants.

THE GOLD IN SULPHUR MINING

To-day, and for 20 years past in the history of the Union Sulphur Co., we have a tale of riches that vies with the wonderworkings of Aladdin's mythical lamp. Organized in 1894 with a capital of $400,000, but $200,000 issued, it has been paying dividends claimed to be no less than 100 per cent. a month or $2,400,000 a year. The stock is held by the second generation of four families—Frasch, Twombly, Hewitt and Severance.

The story of the company's undertakings credits Herman Frasch, a German immigrant at 16, who later developed a method of purifying paraffin wax and desulphurizing petroleum, with organizing a syndicate to exploit the supposedly unworkable sulphur deposits in Louisiana. Measurements showed the deposit was a hill nearly circular, half a mile in diameter, at least 1,100 ft. deep, and covered by 500 ft. of quicksand. Frasch drove down a 10-in. pipe through which was poured water at 335 degrees, which temperature corresponds to a steam pressure of about 100 lb., gage, liquefying the sulphur, which then was pumped up.

A battery of 15 to 20 boilers heats water for each well, more than 1,000,000 barrels of oil a year being burned. A well produces 400 to 500 tons a day for months, one well yielding 73,000 tons, worth $22 a ton. Two or three great wells were brought in in 1914.

The sulphur is poured into wooden bins 350 ft. long, 250 wide and 60 ft. high. Explosives are used to break up the sulphur after solidifying. The United States output in 1880 was 536 tons, worth $39 a ton. In

1914 it was 328,000 tons, practically all by Union Sulphur Co.

The sulphur is practically pure, and needs no refining and little labor. Cost for labor, fuel, etc., is about $2,160,000 a year, and revenue, even at $18 a ton, must be about $5,760,000, leaving net of $3,600,000 on $200,000 capitalization.—*Min. & Eng. World.*

A NOVEL DRILL TEMPERING PROCESS

In a series of comparative tests of piston-drill bits made at the School of Mines, University of Missouri, the following method was tried for tempering drill bits, and it was stated that better results were secured than with any other method:

The graphite crucible containing a small quantity of salt (NaCl) was placed on the forge and the salt melted. The melting point is about 800 deg. C., (1472 F.) which is slightly above the critical temperature of the drill steel used. The steel to be tempered was placed on end in the crucible, the molten salt covering the bit to a depth of about 1½ in. The steel was left in the salt until, on removing, the salt no longer clung to it; in other words, until the steel had reached the temperature at which salt melts. The salt itself got considerably hotter than its melting point, but by watching the steel carefully, it was possible to remove it almost immediately after it had attained the proper temperature. The steel was plunged directly into a bucket of freshly drawn water. The temper obtained in this manner was believed to be as nearly uniform as it would be possible to get with any method without the use of much more elaborate apparatus. The bits were hard and tough and stood up remarkably well. It was not uncommon to drill from 12 to 15 ft. in hard granite with one piece of steel which certainly indicated a good temper for the bit.

SHOP SIGNALS

Mr. H. V. Haight, Chief Engineer Canadian Ingersoll-Rand Company, Sherbrooke, Canada, writes as follows in *American Machinist*:

In our shop we tried both automobile horns and an 8-in. electric gong, but did not find that either of them could be heard very well more than 100 ft. away. We got a good suggestion from the Canadian Pacific Ry. shops in Montreal, to the effect that they were using locomotive whistles with electrically operated valves controlled from the timekeeper's office. It was stated that these whistles could be heard distinctly all over the shop, which is over 1,200 ft. long. We found, however, that the electrically controlled valves were an expensive proposition and as an experiment put in a 1-in. pipe line direct from the power house with a 2½-in. short bell whistle at the end of it. There is a quick-opening valve in the power house. The whistle can be heard very plainly all over the shop, which is 200x325 ft. The whole equipment is very simple and satisfactory.

I have a theory that both the gong and the automobile horn make a noise so much like the ordinary noise of the machine shop that they cannot be readily distinguished. A similar experience with an alarm for a thread miller confirms this belief. The alarm was used to give warning before the spindle reached the end of the travel, to prevent a smash. I arranged a small, mechanically operated gong that made a great noise in the store where I bought it; but after it was installed in the shop, it could hardly be heard 10 ft. away. I think I will try a little compressed-air whistle on the next machine.

NOTES

The Excavation for the Rogers Pass Tunnel was finished on July 6. In the past year more than 3½ miles has been excavated—working from two headings. This double-track tunnel is being built for the Canadian Pacific Ry., by Foley Bros., Welch and Stewart. A. C. Dennis is superintendent for the contractor.

Dispatches from Rome announce that a violent earthquake on July 6 caused the loss of many lives, variously estimated at from 100 to 300, in the sulphur mines of the district of Caltanissetta, Sicily. It is stated that the victims were in three sulphur mines, which the earthquake caused to cave in. This is the only instance, which we can recall, of an important mine disaster resulting from an earthquake.

Out in California a centrifugal blower, driven by an electric motor, is being used in the shelling of almonds. Formerly the nuts could be shelled by hand only with the greatest difficulty. At the present time the almonds are fed into the suction side of the fan, where they are picked up by the runner and hurled

against the fan casing, following which they are blown out of the discharge pipe into a box, already shelled.

One thousand and thirty-six U. S. patents were issued under the weekly date of July 4.

The United States has 68 ports each doing an annual business of more than 1,000,000 tons or a valuation of $30,000,000.

Five tons of newspapers and seven and a half tons of dirt are cleaned off the steps and platforms of the New York subway station every twenty-four hours.

It is estimated that something like 300,000 men have left the coal mines of Great Britain to either join the army as soldiers or to enlist in the special entrenching and tunneling corps.

Five hundred and two feet of advance in one month was made last January in the Tiger adit (8 by 9 ft.) of the Burma Mines Corporation by Chinese miners, under white shift-bosses, using three Leyner-Ingersoll drills at the face and mule traction up to a length of 6,000 ft. The rock is rhyolite.

Baking powder, sugar, artificial silk, silk stockings, twine, furniture, milk bottles, rugs and "the strongest paper ever made" are some of the things which the National Lumber Manufacturers' Association of Chicago reports as being successfully produced at Madison, Wis., in the forest products laboratory of the United States Department of Agriculture.

Last year there were almost 2,500,000 motor cars registered in America, or one for every 44 persons. Iowa led with one for every 16 persons. The number of motor cars in 1915 was almost double the number in 1913. Motor car owners paid more than $18,000,000 in taxes in 1915, most of which went into road improvement.

The following we clip from a daily newspaper of recent date and it may be news: "A company has been formed at Boston to manufacture liquid air for automobiles and as the driving power for all kinds of machinery. By the use of liquid air the company claims that an automobile can make a trip of 100 miles at a very small expense."

Frank Gartland, of the Pueblo, (Colo.) Gas & Fuel Co., has gained quite a reputation as a specialist in the cure of hay fever in adults and whooping cough in children. He has successfully treated about 15 children and a half dozen grown persons. The Gartland whooping cough treatment consists in having the children inhale fumes from the scrubbers, while for hay fever the patients inhale the fumes from the ammonia machine.

Joseph Taylor, a coal operator of Belleville, Ill., has submitted to the Commercial club a proposition for tunnelling under that town by removing the coal strata for the purpose of diverting part of the flow of the Richland creek and preventing floods. Mr. Taylor is willing to assume the work of driving the tunnel through for the sake of the coal which would be removed.

Blowing cotton from one department to another through suitable tubes is the latest employment of compressed air in manufacturing plants. In one instance a California felt manufacturer makes use of compressed air for conveying damp wool from the scouring plant squeezers to another building across the street, in which are located the sun-exposed drying rooms. The method is of course clean and rapid.

A drilling contest between a single-jacker and a jack-hamer arranged by Louis A. Rehfuss, West Point, Calaveras County, Calif., resulted in the jackhamer, with air at 60 lb., drilling 81 in., while the hammersman drilled 9 in. The cost per jackhamer shift figured out 1.75 times that of the hand-drilling shift, but the cost per foot of hole drilled by the jackhamer figured only 19½ per cent. of the cost of hand-drilled hole.

The old steam calliope of the circus parade is being superseded by an air operated apparatus which is superior in many ways. Where the steam calliope had 32 pipes the new instrument has 43, or even 55 whistles, ranging in diameter from ½ in. to 5 in. and up to 4½ ft. in length. Pressures used range from ¾ to 20 lb., and the blower or com-

pressor is driven by a gasoline motor, or, when stationary, by electricity.

A disastrous dust explosion in No. 3 grain elevator of the Pennsylvania R. R. at the Canton terminal at Baltimore, Md., destroyed the structure and the 1,000,000 bu. of grain it contained, and set fire to a 700-ft. pier and two steamships. Five were killed and the property loss amounted to $2,000,000.

In denying the right of a mine driver to recover for injuries sustained when he was kicked by a mule which he was driving, on striking the animal with a whip, the Kentucky Court of Appeals said: "The mule would have been untrue to itself and to every tradition of its breed if it had kept its heels on the ground and an employee cannot court danger by inviting a mule to kick him and then recover for consequent injuries."

Baltimore was the first city in the United States to establish public gas lighting. The Gas Light Co. of Baltimore on June 17, 1816, received a franchise from the City Council to lay pipes for distributing gas. This was only four years after the introduction of gas light in London by the Gas Light and Coke Co., the first gas undertaking in the world. Boston introduced gas lighting in 1821 and New York City in 1823.

An electrically-operated cleaner for blackboard erasers has lately been introduced by an American manufacturer. It consists essentially of a vacuum fan operated by a 1/25th horse-power electric motor. Not only is the chalk dust removed by the strong suction of the fan, but the surface of the eraser is cleaned by a rotating bristle brush. The chalk is drawn into a box, from which the air escapes through a fine muslin filter. It is claimed that no chalk escapes into the room.

Dr. Robert Gans, of Pankow, near Berlin, Germany, has been awarded the Elliott Cresson gold medal by the Franklin Institute for his discovery and development of "Permutit." Permutit is sodium-aluminosilicate used for softening water, having the remarkable property of exchanging its sodium for the hardening ingredients—calcium and magnesium—in water filtered through it. When the "Permutit" has been exhausted of its sodium, it may be regenerated with a solution of common salt.

Elephant Butte dam in the capacity of its reservoir ranks every other storage dam in the world completely controlled by man. Its reservoir when full will contain 856,000,000,000 gal., or enough to cover the State of Delaware 2 ft. deep. This is a third more than is stored by the $17,000,000 Assuan dam in Egypt and two-thirds more than the combined capacity of all the reservoirs built or projected for Greater New York City. On top Elephant Butte is 1,674 ft. long; it contains 610,000 cu. yd. of rubble concrete and weighs a million tons.

The remarkable growth of the aeroplane industry of the United States is indicated by the exports of 398 aeroplanes for 1915 against 40 in 1914 and 19 in 1913. The value of the 1915 exports was $2,960,814 or an average of $7,439 per machine, against $6,337 in 1914 and $3,227 in 1913. The exports of aeroplane parts were also very large, amounting to $2,457,782 as compared with only $145,997 in 1914 and $25,606 in 1913. Imports of aeroplanes into the United States decreased from 16 and 13 in the fiscal years of 1912 and 1913, respectively, to only 1 each in the fiscal years of 1914 and 1915.

There has been a superstition about accidents that they were something inevitable, the outcome of fate. When the pious workman lost his leg, it was God's will. If he was not a religious man he said the accident "was coming to him," and the man beside him said, "I am going to get mine some day." That was the way workmen talked in general 15 to 20 years ago. And the man at the factory or railroad had the same attitude: "Accidents are unavoidable. It's one of the prices we pay for progress." Blood and shattered bodies, that is the price we were paying for prosperity, and the public at one time agreed that the cost could not be avoided.—Ida M. Tarbell.

Protection of a large gasolene tank at Balboa, on the Panama Canal, against accidental ignition of its contents is being carried out on the Martini-Hueneke system. The principle of the system is the maintenance of a blanket of incombustible gas in the storage tank above

the surface of the gasoline. The plant consists of a gasoline engine driving a gas compressor, gas scrubbers, and an inert-gas storage tank. The inert gas used is the exhaust from the gasoline engine, which is cooled, scrubbed and compressed into a high-pressure storage tank. As fast as gasoline is drawn out of the storage tank the inert gas is automatically supplied to the space above the gasoline, so that no air is drawn in.

Compressed air, the air which is compressed in front of a projectile in flight, is an important factor to be reckoned with in the designing of anti-air craft guns, and in the study of their action and efficiencies. A single instance of the complications encountered is seen in the study of falling bodies. Gravity of course, if not interfered with, produces a constantly accelerated drop, but this is opposed and may be entirely negatived by the gradually increasing resistance of the air. When this resistance equals the force of gravity, no matter what the height may be, there can be no more acceleration, and in fact, on account of the increasing density of the air there must be some actual retardation.

A new use for electric air heaters has been found by the St. Marks Hospital of Salt Lake City, Utah. Heretofore a set of four dumbwaiters running from the basement to the first second and third floors has been used for carrying food from the kitchen to the various wards. Great difficulty was encountered in keeping the food warm from the time it left the kitchen until it arrived at its destination. Now the hospital is using seven portable wagons designed by Mr. Chadron, general manager of the hospital. These wagons accommodate 26 trays and are arranged with sliding doors that make them practically air-tight. An electric air heater is mounted on the bottom of the wagon, with a cord and plug attachment capable of being connected 10 feet away from the wagon. An hour before each meal the various heaters are connected to a source of electric current in order to heat the interior of the wagons. After the wagons are loaded, they are placed on an elevator and raised to the various wards. If the meals are not to be taken immediately, the wagons are again connected to any source of electric current.—*Scientific American.*

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents Washington, D. C.

JUNE 6.

1,185,621. POWER - GENERATOR. GEORGE BOLTZ, Amy, Kans.

1. In a power generating apparatus, the combination with an air tank, an oil reservoir, and a combustion chamber, of a water jacket encircling the said chamber and having a steam drum on the upper side thereof, a valved pipe connecting said air chamber and said oil reservoir, a valved pipe extending into said oil reservoir and into the combustion chamber, the said pipe being bent back upon itself within the said chamber and open at its inner end, a valved pipe connecting the steam drum and the combustion chamber, a valved pipe connecting the air chamber and steam drum, a valved pipe extending into the combustion chamber and into the air chamber, a pipe extending into the combustion chamber and having communication with the water jacket whereby water may be sprayed into the said combustion chamber.

1,185,638. MILKING APPARUTUS. REUBEN B. DISBROW, St. Paul, Minn.

1,185,660. PNEUMATIC TIRE AND INFLATION MEANS THEREFOR. REBECCA HARRIS and NATHAN HARRIS, Newark, N. J.

1,185,684. VALVE FOR PNEUMATIC PILLOWS AND OTHER ARTICLES. HENRY P. KRAFT, New York, N. Y., and MAXIMILIAN CHARLES SCHWEINERT, West Hoboken, N. J.

1,185,708. PNEUMATIC FOR SELF-PLAYING MUSICAL INSTRUMENTS. GEORGE H. PARSONS, Stamford, Conn.

1,185,737. FLUID-OPERATED BRAKE. WALTER V. TURNER, Edgewood, Pa.

1,185,809. SUPPORT FOR COAL AND ROCK DRILLS. NILS D. LEVIN, Columbus, Ohio.

1,185,899. HOT-AIR DRIER. CHARLES E. GEIGER, Louisville, Ky.

1,185,942. AIR-COMPRESSOR. MICHAEL RIESNER, Cincinnati, Ohio.

1,185,955. FLUID MOTOR OR PUMP. AUGUST SUNDH, Hastings-upon-Hudson, N. Y.

1,186,079. VACUUM-CLEANER. ROBERT L. COOLEY, Milwaukee, Wis.

1,186,120. TOY GUN. GEORGE MULLER, Newark, N. J.

1,186,201. DEVICE FOR SUPPLYING STEAM AND AIR TO FURNACES. GEORGE R. JARMAN, Baltimore, Md.

1,186,208. VACUUM-CLEANER. EUGENE M. KENT, Rome, N. Y., and BERT M. KENT, Washington, D. C.

1,186,247. GOVERNOR-VALVE FOR AIR-COMPRESSORS. WILLIAM EVERETT, VER PLANCK, Erie, Pa.

1,186,367. FIXATION OF NITROGEN. EDGAR ARTHUR ASHCROFT, London, England.

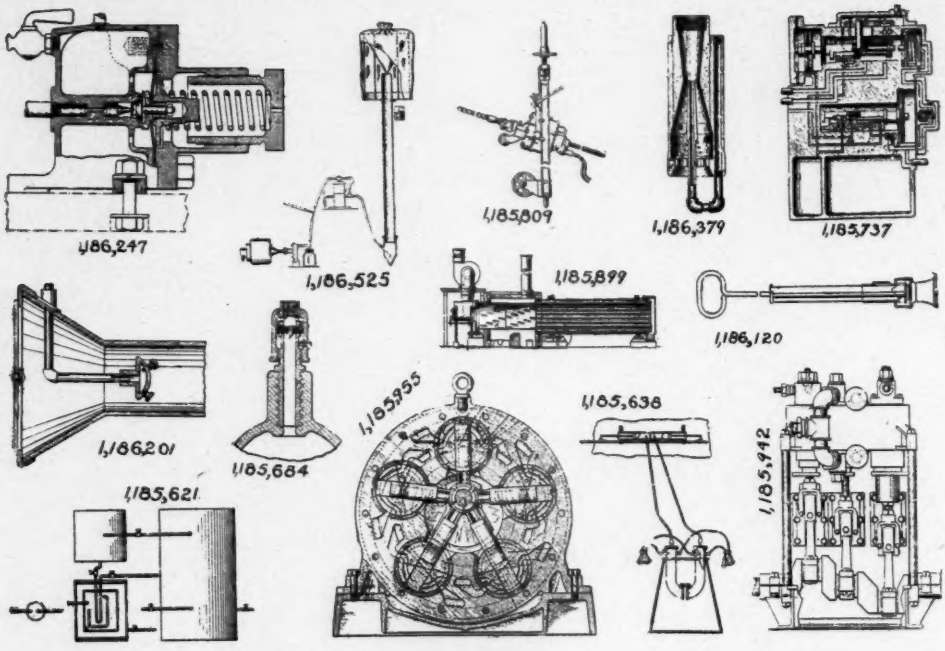
2. The fixation of nitrogen by reacting nitrogen, carbon and a metal under a pressure of at least fifty atmospheres and at a temperature of 300 degrees centigrade and upward.

1,186,369. PNEUMATIC WELL FOR INK AND MUCILAGE. BRONSON BARLOW, Chicago, Ill.

1,186,379. AIR-JET LIFT. THOMAS J. CRUMPTON, Coalinga, Cal.

1,186,525. PROCESS AND APPARATUS FOR SEPARATING AND ANALYZING GRANULAR MATERIAL. JOSEPH C. PEARSON, Chevy Chase, Md.

1. The process of separating granular material consisting in subjecting a confined body of such material to mechanical agitation and a downwardly directed fluid current regulated to maintain the whole mass in movement, deflecting and expanding the current with its suspended contents and causing the same to travel upwardly with uniform flow, and separately collecting the portions separated.

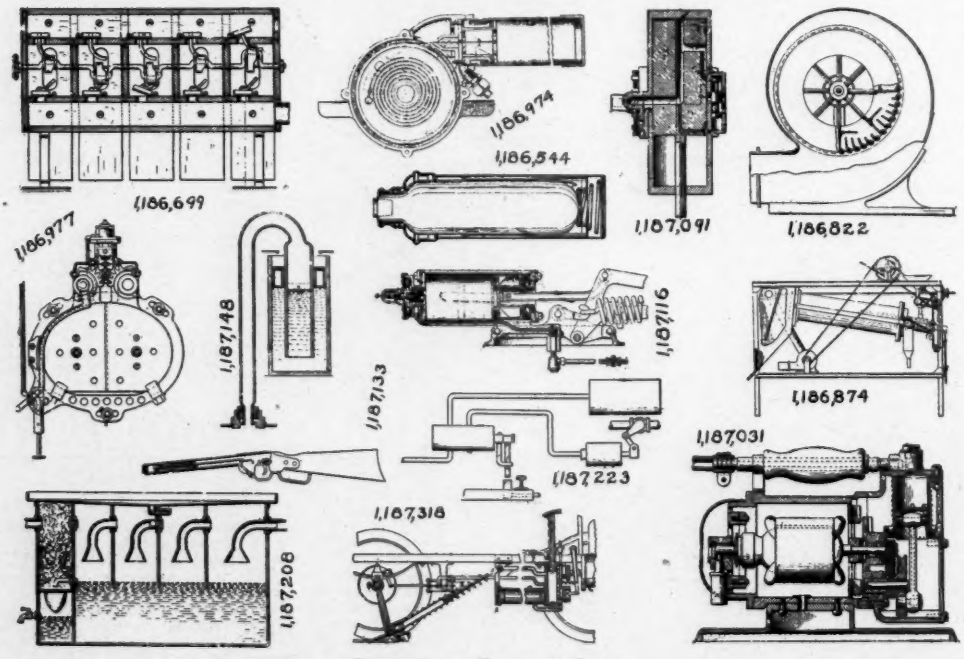


PNEUMATIC PATENTS JUNE 6.

14,146. (REISSUE). METHOD FOR PURIFYING AND HUMIDIFYING AIR. WILLIAM G. R. BRAEMER, Camden, N. J.

JUNE 13.

1,186,544-5. VACUUM-BOTTLE. FREDERICK E. CARLSON, New Britain, Conn.

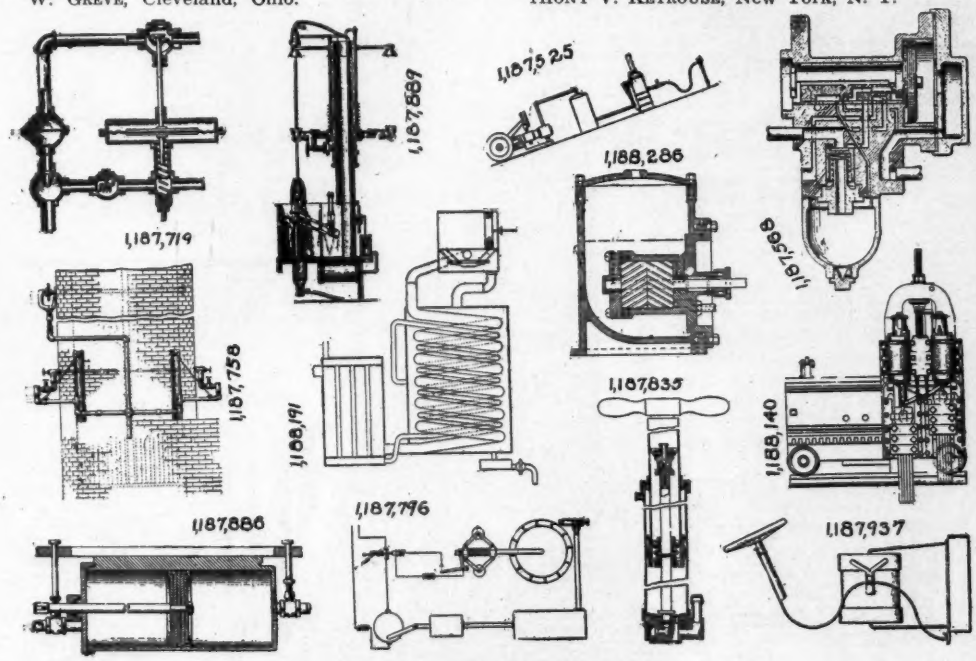


PNEUMATIC PATENTS JUNE 13.

1,186,558. VACUUM CASTING APPARATUS. James E. Dunn, Pittsburgh, Pa.
1,186,572. VACUUM INSULATION. F. Walter, Guibert, Detroit, Mich.
1,186,699. PNEUMATIC MOTOR. David C. Spence, San Maeo, Cal.
1,186,822. BLOWER. Christian Neumann, St. Louis, Mo.
1,186,826. FAN - BLOWER. James Robert Peifer, Sheppton, Pa.
1,186,874. VACUUM ORE - SEPARATOR. Harry H. Baer, Orrville, Ohio.
1,186,974. PNEUMATIC STARTER FOR INTERNAL-COMBUSTION ENGINES. John Desmond, Wilmette, Ill.
1,186,977-8. FIRE-DOOR APPARATUS. Albert G. Elvin, Somerville, N. J.
1,186,981. FLUID-OPERATED TOOL. Louis W. Greve, Cleveland, Ohio.
1,187,395. PNEUMATIC HAMMER. Charles H. Shaw, Denver, Colo.
1,187,416. VACUUM-CLEANER. Benjamin R. Chase, Boston, Mass.
1,187,428. CENTRIFUGAL BLOWER AND LIKE MACHINE. Thomas Henry Collett Homershan, Bradford, England.

JUNE 20.

1,187,508. AUTOMATIC AIR - COUPLING. Charles H. Davenport, Elk Park, N. C.
1,187,512. ELECTROPNEUMATIC BRAKE. Edward H. Dewson, New York, N. Y.
1,187,525. AUTOMATIC DAMPER FOR COMPRESSED-AIR REHEATERS OR THE LIKE. Fred D. Holdsworth, Claremont, N. H.
1,187,533. AIR-MODIFYING DEVICE. Anthony V. Keyrouse, New York, N. Y.



Pneumatic Patents June 20.

1,187,031. AIR-COMPRESSOR. Samuel D. Black, Baltimore, and Alonzo G. Decker, Orangeville, Md.
1,187,091. FLUID-PRESSURE ENGINE. John Cooper, Porter, Northampton, Mass.
1,187,116-7. TROLLEY-RETRIEVER VALVE. Frank A. Wasson, Milwaukee, Wis.
1,187,133. AIR-GUN. Julius Chein, Montclair, N. J.
1,187,148. PRESSURE INDICATING AND CONTROLLING MEANS. Miller Reese Hutchison, Summit, N. J.
1,187,184. AIR - PIPE COUPLING FOR TRAINS. Fred H. Seely, Creston, Iowa.
1,187,208. DUST-COLLECTOR. Frank X. Wahl, Chicago, Ill.
1,187,209. PNEUMATIC TRACK AND STREET CLEANER. Frank L. Warner, Rockaway Beach, N. Y.
1,187,223. TRAIN-STOP. Simon I. Youngen, Vermilion, Ill.
1,187,277. WINDOW-GLASS BLOWING OR DRAWING MACHINE. Harry E. De Vaughn, Morgantown, W. Va.
1,187,318. AIR - BRAKE FOR VEHICLES. Frank A. Homes, St. Joseph, Mo.
1,187,568. FLUID-PRESSURE BRAKE. Walter V. Turner, Edgewood, Pa.
1,187,719. VACUUM-VALVE. Alexander Des Rocher, Detroit, Mich.
1,187,758. BLOWER FOR UPRIGHT WATER-TUBE BOILERS. John Magee, Detroit, Mich.
1,187,796. FLUID - PRESSURE GOVERNOR. James G. Zimmerman, Milwaukee Wis.
1,187,835. PORTABLE AIR - COMPRESSOR. Ernest Henry Hill and Harold Hill, Sheffield, England.
1,187,886. DOOR-OPERATING MECHANISM. Wayne W. Brown and John B. Parshall, St. Louis, Mo.
1,187,889. GLASS-BLOWING MACHINE. Vernon M. Dorsey, Laurel Grove, Md.
1,187,937. MEANS FOR SUPPLYING MOISTURE AND AIR TO AUTOMOBILE-ENGINES. Albert N. Stephan, Freeport, Ill.
1,187,938. CAR AND AUTOMATIC AIR-BRAKE COUPLING. Robert D. Stroup, Shyrock, W. Va.
1,188,140-1. CHANNELING-MACHINE. Albert Ball and Henry H. Mercer, Claremont, N. H.
1,188,143. PNEUMATICALLY - ACTUATED TOOL. Albert Ball, Claremont, N. H.

1,188,191. PROCESS OF LIQUEFYING GAS-MIXTURES AND FOR SEPARATING THE CONSTITUENTS. RUDOLF MEWES, Berlin, Germany.

1. The described process for separating gases, especially for obtaining nitrogen and oxygen in any degree of purity, which consists in feeding gases under pressure to a point of expansion in counter current to expanded gases coming from said point of expansion, without however mixing said gases, in vaporizing the liquid formed, and in simultaneously alternately heating and cooling the gases given off by the vaporized liquid, substanially as, and for the purpose, set forth.

1,188,286. AIR-PUMP FOR EITHER VACUUM OR PRESSURE. GEORGE I. LEONARD, Los Angeles, Cal.

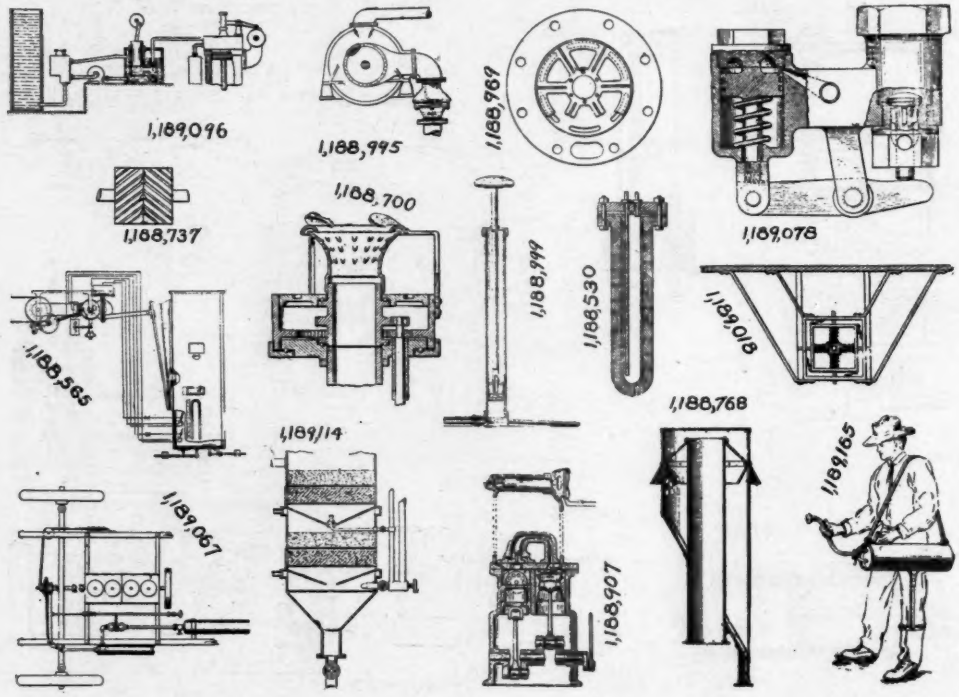
valves adapted to limit the increase and reduction of pressure; and means independent of said valves for varying the range of pressure within the limits for which said valves are set, during operation of the pressure increasing and reducing means.

1,188,700. PNEUMATIC COTTON - PICKER. THEODORE E. STRAUS, Baltimore, Md.

1,188,716. PNEUMATIC ACTION FOR PIANOS AND THE LIKE. CLEMENCE T. BEITEL, Washington, D. C.

1,188,737. ROTARY PRESSURE OR VACUUM PUMP. WILLIAM CLIFTON CUTLER, Sawtelle, Cal.

1,188,768. DUST-COLLECTOR. HERMAN HERMANSEN, Baybridge, Ohio.



PNEUMATIC PATENTS JUNE 27.

JUNE 27.

1,188,530. APPARATUS FOR WORKING WITH HYDROGEN UNDER PRESSURE. CARL BOSCH, Ludwigshafen-on-the-Rhine, Germany.

1. Apparatus for working with flowing hydrogen under continuous pressure and at raised temperatures, comprising an inner vessel which is of itself incapable of permanently sustaining the pressure employed, means for supporting the said vessel to enable it to sustain the pressure, which means are not capable of retaining gas under pressure and means for supplying gases to and from the said vessel.

1,188,565. APPARATUS FOR TREATING DISEASE. MELVIN L. SEVERY, Arlington Heights, Mass.

1. An apparatus of the character described, comprising in combination, a receiver adapted to inclose the body or member to be treated; means for alternately raising the pressure above and reducing it below atmospheric pressure;

1,188,907. PNEUMATIC TOOL. ERNESTO CURTI, Milan, Italy.

1,188,969. VALVE FOR AIR-COMPRESSORS, ETC. WILLIAM F. MEISTER, Marietta, Ohio.

1,188,995. MEANS FOR STOPPING PULSASATIONS IN CENTRIFUGAL COMPRESSORS. RICHARD H. RICE, Lynn, Mass.

1,188,999. AIR-PUMP. FRANK I. ROSE, Hastings, Nebr.

1,189,018. AUTOMATIC AIR - COUPLING. CLAUD L. TURNER, Gering, Nebr.

1,189,067. FLUID - PRESSURE ENGINE-STARTER. BIRGE W. DAVENPORT, Minneapolis, Minn.

1,189,078. PNEUMATIC CYLINDER - COCK. OWEN E. EVANS, El Dorado, Ark.

1,189,096. PUMPING APPARATUS. CARL GRUNWALD, Bredeney, Germany.

1,189,114. APPARATUS FOR THE FILTRATION AERATION, AND GASIFICATION OF LIQUIDS. THOMAS KEMPLAY IRWIN, London, England.

1,189,165. COMPRESSED - AIR SPRAYER. WILLIAM NESS, Spring Grove, Pa.